

VIRGINIA WILDLIFE

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ONE DOLLAR



Sharing the Waters
From River to Sea
A Special Issue



It was nearly midnight. There was no moon in the sky. Kevin pulled out the worn-out plastic doll from his truck and murmured a few words over her. Then he gently plucked a couple of hairs from her nearly bald head and flung them into the water below us.

It was time to begin.

We pulled on our damp wetsuits, grabbed flashlights and nets, and descended down the riverbank. We were on a search for something exceedingly rare; something that might never, ever be found again, except, perhaps, in our dreams. We needed all the good luck we could conjure.

"You don't treat her right and bad things happen to you," Kevin spoke slowly. "Baby Blood" was one of the many discarded baby dolls one can find caught in the twigs and logs of our rivers, long bereft of their pretty pink dresses and knitted booties. Kevin, a VA Tech graduate student working on the Clinch and Holston Rivers in southwest Virginia, had rescued her one day, and now, along with a dash of the macabre, she has become a good-luck charm.

His eyes widened dramatically as he told tales of awful misfortune befalling those who dared make fun of Baby B. "You've got to rub her head and tell her how pretty she looks," he said. "Then she'll help you find what you're looking for. I've seen it happen."

We slid into the water, pushed our faces beneath the surface. Our lights lit up the bottom falsely, like an aquarium, and slow-moving perch stared dreamily at us, barely moving their fins. Crayfish crept slowly along the sand, flanked always by a rock to scuttle under. And the minnows, silver linings zipping down their sides, flashed at us in and out of the white light and darkness. But we tried to keep our eyes on the silty bottom underneath us.

Motionless between or behind fist-sized rocks, minnow-sized green-sided darters with squiggly lines tattooing their heads and bodies allowed us to nearly touch them in the unearthly light, suspended, entranced in the night.

But we were looking for something else; praying to find something else. The yellowfin madtom, a diminutive catfish

the size of your little finger was eluding us. Or perhaps it was not to be found at all. We had been told that this fish was most easily glimpsed at night, when it emerged from under rocks to hunt for food. But we had no knowledge of its whereabouts. We were sadly ignorant of its life, its history, its very existence.

Baby Blood must have been offended that night. We found no yellowfin madtoms, even though earlier in the spring a single female full of eggs had been captured in a snorkling expedition. It is hard to believe that just 10 years ago this fish had been one of the most common collected on this stretch of river...

In September, deep-purple ironweed and blue-purple lobelia cover the roadsides in the river valleys of southwest Virginia. Old men cut and pile tobacco up on sticks to dry beside the rivers. They plant these bottoms, since the mountains do not keep their distance on the horizon. Cows cool themselves in the rivers, stirring up mud and silt. Farmers lose precious topsoil to the rivers during storms. People wash away their sins in the rivers, as the unwanted, unused, and discarded find their way into the waters, swirl and disappear.

But rivers here run eternal. Floating on the surface, head underwater, moving slowly inch by inch upstream with your hands and forearms pushing gently against the bottom, life turns somersaults. Like figures coming alive from the pages of a fairytale, creatures that breathe water, swim with fins edged in gold, crawl with claws and bodies painted in neon green, and move headless and blind for centuries—become real.

Only in this secret place, where the mountains nearly consume you, where the people are older than they are young, and where the rivers run undammed, can you witness this. No one knows why this is the only place in the world where there are more species of the fairy-like darters, the long-lived mussels with their shells of pearl-white, lavender and rose, or spiny softshell turtles with their snake-like necks and pointy noses. It just *is*—for now.

My friend Sue lost some part of herself a few years back in Copper Creek and the Clinch River. You can tell, because whenever she goes back, she is

forever trying to retrieve it. She slowly wanders downstream alone, searching always for the muskrat middens that will reveal the joyful news that the old, old mussels in the rivers are reproducing again, are renewing themselves as they have done for thousands of years. But the babies, the discarded young mussel shells in the middens that would tell of another generation taking hold in the rivers she loves, are never there when she looks for them.

Instead, we gently pull up the half-century old live mussels from their beds on the bottom, measuring and counting them carefully before nervously replanting them in what we hope will be suitable, comfortable places to live. We worry about respecting our elders.

Nevertheless, we keep looking. On dreary days, Sue wonders how it will ever be possible to bring the public to think fondly of a mussel. "Mussels don't even have heads," she moans.

Truthfully, even while searching for mussels, it is the green-sided, the tangerine or the Tippecanoe darters that always divert us with their delicate colors, their transparent movements, and their strange and ethereal beauty. We are cursed with a love for the flamboyant.

Still, there is always hope. After all, those 50-year-old mussels haven't given up yet. Every year they spew out their eggs with the boundless faith of the living. It's just that none of their young have survived.

Sue once confided in me her respect for fellow mollusk researcher Dick Neves. With his quiet manner, his persistent and patient movements to save the last of this wonderful family of headless, remarkable creatures, I cannot help but feel that he has learned a way to survive from the animals he studies. Something tells me he has found far more potent a charm than Baby Blood to keep his spirits from failing. □

Sharing the Waters From River to Sea A Special Issue



Baby loggerhead sea turtles; photo by Lynda Richardson.

Cover: West Indian manatee; photo by Laura Osteen, marine mammal images.

Back cover: Mussel in the Clinch River; photo by Lynda Richardson.

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The aquatic animals making their home in Virginia's fresh and salt waters face a future that no fortune cookie can foretell. Humans view water as a problem only when it is inadequate to meet our demands or when it jeopardizes our health or safety. However, for animals that live in it, any and all changes to this life-sustaining medium are potential threats to their continued existence.

In school, we learned that the hydrologic cycle, which explains how water is continuously recycled from the oceans to earth, and then back again, sustains life both on earth and in the ocean. Just as a drop of water can be found in a stream, in the ocean, or in a cloud during some period of its cycle, the similarity and dependency of freshwater and marine animals are inextricably linked. What happens on land gets into running water and eventually makes its way to the estuary and ocean. All of these aquatic habitats consist of a patchwork of chemical and physical environments, occupied by different communities of plants and animals, each adapted to its place in this linear chain of aquatic ecosystems.

In the stories that follow, we provide an overview of the lives of marine mammals and turtles, and freshwater mussels. What do such unlikely bedfellows have in common, among themselves and with humans? All three groups of animals are extremely long lived, harvested by humans in some portion of their distributional range, and are experiencing the loss and degradation of habitats critical to their survival. Human dominance on land has severely affected water quality in rivers, bays and oceans and has caused degradation to habitat quality in river bottoms by siltation, to seashores by construction and development, and to coastal waters by dumping, overfishing and

mismanagement. Wherever aquatic species call home, the human influence is inescapable.

It's been said that the power of humans to alter the earth is awesome, but the ability to repair those alterations is mythical. Animals and ecosystems exhibit varying degrees of resilience; that is, the ability to take our abuse, and to be able to recover over years or eons of times. However, for many of Virginia's endangered aquatic species, the window of opportunity for recovery is quickly closing. Without our benign intervention—to cease the degradation, and assist with protection and propagation—many of these animals will become only memories of Virginia's natural heritage.

The plight of mussels, sea turtles and marine mammals may seem far removed from us. It may seem as if you and I have no influence over their lives whatsoever. Yet, let us think again. If life were a game of dominoes, and if each domino represents an individual species on this planet, let us not forget that we too are in the lineup. Our actions will determine the final outcome of this game of cause and effect. Correct moves on our part not only will improve the chances for mussels, sea turtles and marine mammals, but also for ourselves.

The time is right to begin a new game of dominoes, and it's our generation's move. For the continued existence of all species, we must move cautiously and carefully. Let the game commence. □

Sue Bruenderman

Sue Bruenderman, VDGIF Aquatic Biologist

Dick Neves

Richard Neves, Unit Leader, VA Cooperative Fish and Wildlife Research Unit, VA Tech

Brooding Over Mus



by Dr. Richard Neves

The U.S. has the greatest diversity of freshwater mussels in the world—and they are in immediate danger of extinction. Here's the story of a heroic, last-ditch effort in Virginia to save them.

The freshwater mussels in Virginia and throughout North America are in deep trouble. Of the nearly 300 species residing in North America, the consensus of mollusk specialists is that 47% of our mussel fauna is either threatened, endangered, or extinct at the present time. No other group of animals is at such high risk to disappear forever.

Because the United States has the greatest diversity of freshwater mussels in the world, this loss of mussel species is of global significance, as are our efforts to conserve and protect these animals. Freshwater mussels represent millions of years of evolution and adaptation to

streams and rivers, and yet in the proverbial blink of an eye, we are about to experience the greatest loss of mussel species in recorded time.

Recovery of all aquatic species, whether mussels or fish, requires long-term efforts to improve water quality and restore riverine systems, as well as sufficient biological knowledge to prevent extinction and encourage their reproduction. The stress to healthy populations caused by degraded habitats and the imminent danger of zebra mussels pose an ominous future for all aquatic life in our rivers.

While state and federal regulatory agencies attempt to address

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Lynda Richardson

Freshwater mussels have developed a remarkable reproductive strategy which is dependent on the presence of specific fishes in their environment. These fish "hosts" act as surrogate mothers for tiny developing mussel larvae, nourishing them while they are attached to their gills until the young mussels complete their transformation into pinhead-sized juveniles. Pictured next to the mussel in this photo (above) is a sculpin, which serves as a fish host for several mussel species. **Right:** A collection of common, state and federally endangered mussels found in southwest VA rivers.

wrongdoings in and along our waterways, we set out on a mission in 1989 to investigate and improve upon techniques for the propagation of mussels threatened by the deliberate and benign neglect of humans in Virginia.

The propagation and culture of

freshwater mussels in the U.S. has a fascinating history which began in 1890, to provide shells for a growing pearl button industry. Prior to that time, buttons were made from marine shells, wood, metal, bone and other materials. The discovery that buttons made from freshwater mussel shells were cheaper and of excellent quality provided the volume of buttons needed for a new ready-to-wear clothing industry. Shell gatherers would collect the live mussels and cook them in large vats to remove the meat. The shells then would be shipped to button factories along the river, where they would be cut, polished, drilled, and sewn onto cards for shipment to clothing factories and department stores nationwide.

By 1914, more than 150 button factories were operating in the upper Midwest. During these button boom years (1890-1920), and before the use of plastic buttons, hordes of nearly 10,000 shellers in the Mississippi River system pilaged the resource, exploiting each area to commercial extinction before moving on to new locations.

Because some mussel species have life spans approaching 100 years, it takes decades for a population to recover from overharvest. As hundreds of millions of animals were being taken to churn out the desired white buttons, there arose a public outcry to protect and sustain the mussel fishery.

In the late 1890's, fishery scientists recommended a minimum size limit to protect small shells, a ban on shelling during the spawning season, and the use of artificial propagation to prevent the extinction of commercially exploited species. Beginning in 1907, biologists with the federal Bureau of Commercial Fisheries began experimenting with mussel propagation.

Unlike birds and mammals, however, mussels don't make it easy for us to

help them multiply. In nature, mussel larvae (called *glochidia*) are released from the female and drift in the water, where they must attach themselves to a suitable host fish. Because of this unusual reproductive cycle, most larvae never make it beyond this stage.

During a brief period of parasitism on the fish, the larvae metamorphose to baby mussels and drop from the fish to begin life in the river bottom. The young mussels are smaller than a pinhead in size and are subject to the whims of nature. Many of the newly transformed mussels drop from the fish into unsuitable habitats and die.

Therefore, although an estimated 1 billion larvae attached to host fishes were released annually by the Bureau of Commercial Fisheries into public waters over more than 20 years, only about 2% reached adulthood under the best of conditions.

In addition to the release of fish infested with mussel larvae, biologists conducted studies to rear young mussels in tanks, ponds, and crates floated in the Mississippi River in the early 1900's. They had favorable success with some of the thin-shelled species, but very limited success with the thick-shelled



Lynda Richardson

species that were of commercial value. In 1922, the consensus of researchers was that "if the natural supply is not maintained and the price of shells continues to advance, there will possibly come a time when rearing of mussels by a complete system of culture will become commercially profitable."

By the late 1920's, there was little natural reproduction of mussels in the upper Mississippi River because of water pollution and silt from erosion. Similarly, the failure of artificial propagation was attributed to pollution and habitat loss. Freshwater mussels, a river's biological filter, were being suffocated, choked, and killed by the gross pollution of the riverine environment. The opinion of most scientists by the 1930's was that propagation of mussels was futile unless water quality improved substantially to allow recovery of the severely exploited mussel populations residing in the rivers.

When plastic replaced shell in the manufacture of buttons, interest and efforts in mussel propagation died, until the federal Endangered Species Act was passed in 1973. Twenty-three of the 300 species in the U.S. were placed on the federal Endangered Species List in the mid-1970's, and seven of these occurred in Virginia. Since that time, the federal list has grown to 57 protected mussel species, and nearly half of those occur in the upper Tennessee River system, mostly in southwest



Richard Neves



Lynda Richardson

Top: Researchers at VA Tech have developed algae diets which will be used as a substitute for rearing young mussels outside of their natural riverine environments. *Above:* Dr. Richard Neves exhibits a sampling of the high diversity of mussels present in southwest VA, all of which are in imminent danger of extinction. His work attempting to raise mussels outside of their natural environments may be a short-term, but essential, avenue of protection for these species.

Virginia and eastern Tennessee.

The Virginia Department of Game and Inland Fisheries (VDGIF) and the Tennessee Wildlife Resources Agency, anticipating further declines and possible extinctions of these rare mollusks, began a cooperatively funded research project to conserve our native mussel species through artificial propagation and culture. Using the techniques developed earlier this century as a base, the Virginia Cooperative Fish and Wildlife Research Unit and graduate students in the Department of Fisheries and Wildlife Sciences at Virginia Tech began studies in 1989 to test and improve upon what had gone before. Because early efforts to artificially infest fish hosts with mussel larvae and release them were not very successful, in that less than 2% of the larvae survived to reproductive age, propagation of young mussels would require more efficient methods.

To rear young mussels in the laboratory or in outdoor facilities, the first hurdle was to induce spawning of adult mussels to obtain a sufficient number of larvae for producing baby mussels. Freshwater mussels consist of separate sexes, so that successful spawning requires a sufficient number of males and females in proximity to each other. Males release sperm into the water, where they will be siphoned into the body cavity of females to fertilize her eggs. Depending upon size, female



Illustration by Pels

mussels can produce between 100,000 and nearly 3 million eggs each spawning season. Once fertilized, these eggs will be stored in the female's gills, where they will develop into mature larvae over a period of several weeks. When the proper environmental conditions of water

temperature and photoperiod are reached, the female will spew out these larvae to hopefully come in contact with a suitable host fish, as described earlier.

To promote successful spawning, we are holding males and females of each species together in cages sus-

tilization of eggs. Once the females are gravid with mature larvae, we select mussels to supply these larvae for our host fish infestations. Using a hypodermic syringe pushed through the edge of the mussel gill, we force water into the gill and expel larvae out into a dish. After several females have been relieved of their larvae, fish species known to be hosts for the mussel are infested with these larvae. The larvae are drawn into a pipette and squirted onto the gills of the fish, where they attach and become encysted after several hours. The fish are held in tanks for 2-3 weeks until the larvae transform to baby mussels and drop from the fish. This baby mussel factory provides the animals needed for our culture experiments.

While this study was underway, we sought to determine whether there was an alternative method for obtaining juvenile mussels, other than through host fishes. Of the nearly 300 species of freshwater mussels in the U.S., we know the host fishes for only 70 of those species. Therefore, we are unable to produce juveniles in the laboratory for most mussel species. Preliminary research conducted by the Tennessee Valley Authority in the early 1980's indicated that an artificial medium could substitute for the nutrition gained by some larvae at-



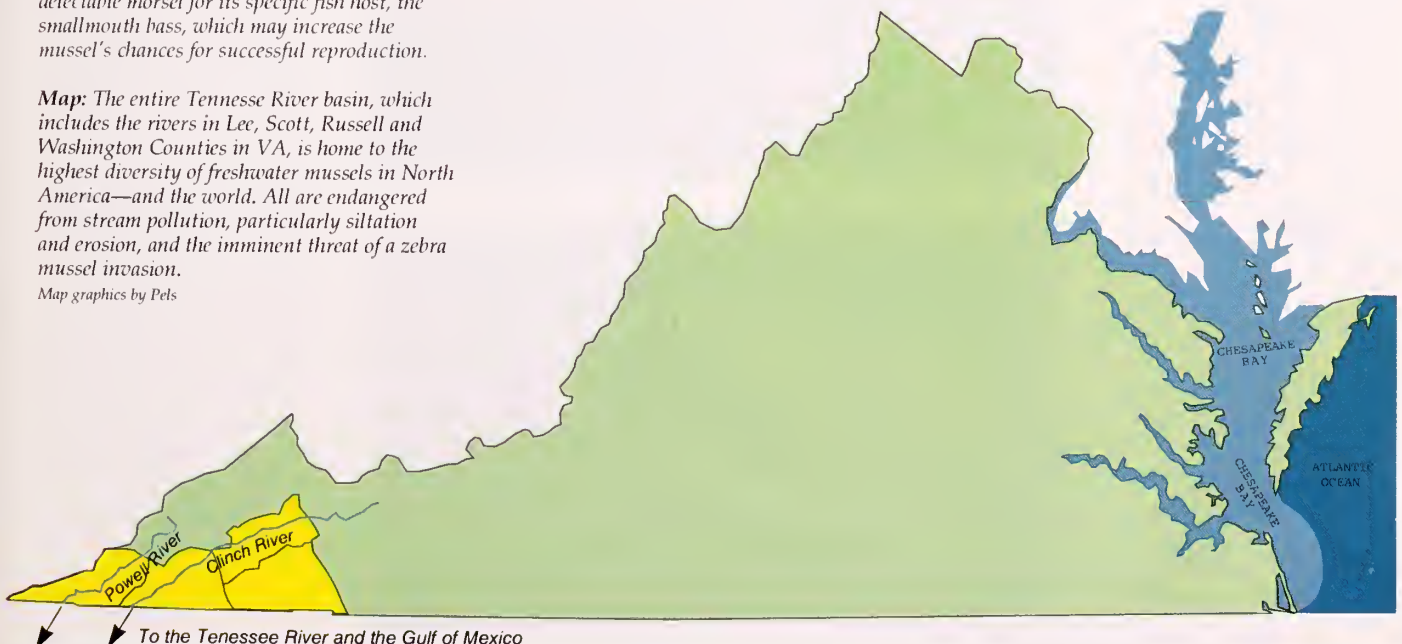
Richard Neves

Above: *Lampsilis ovata*, a mussel species found in our southwest VA rivers, has developed an innovative means of attracting a fish host to take care of its babies. Scientists suspect that its flapping mantle imitates a delectable morsel for its specific fish host, the smallmouth bass, which may increase the mussel's chances for successful reproduction.

pended in a farm pond in Critz, Virginia, and a pond at the VDGIF fish hatchery in Marion. Placing animals together promotes the efficient fer-

Map: The entire Tennessee River basin, which includes the rivers in Lee, Scott, Russell and Washington Counties in VA, is home to the highest diversity of freshwater mussels in North America—and the world. All are endangered from stream pollution, particularly siltation and erosion, and the imminent threat of a zebra mussel invasion.

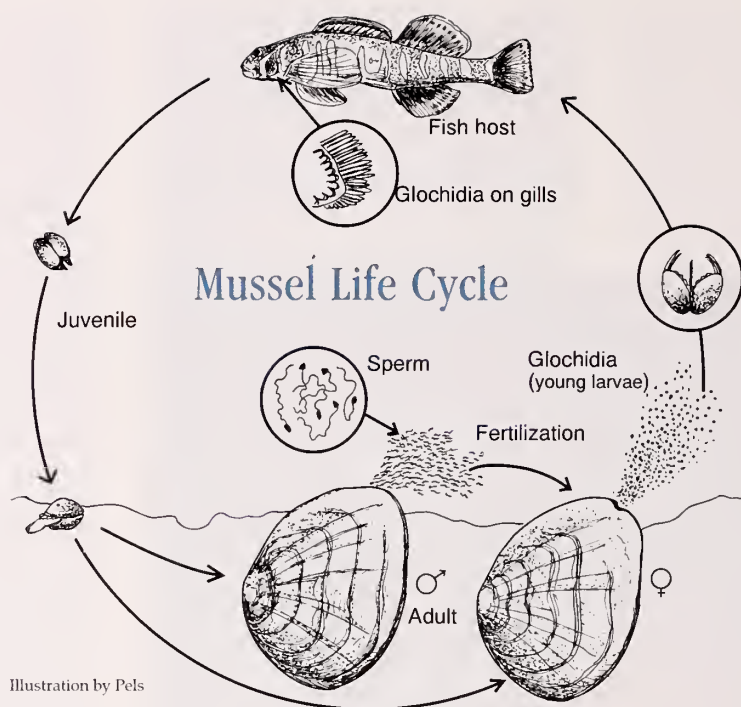
Map graphics by Pels



tached to host fish. This medium contained fish blood and various vitamins, minerals, amino acids, and antibiotics, such that it could function as a fish substitute. Because this medium would provide a simple, effective means to produce juvenile mussels for species with unknown host fishes, it is being tested at Virginia Tech and several other laboratories in the eastern U.S. The goal is to improve and perfect the medium so that the larvae of any mussel can be raised to the juvenile stage.

But the challenges of mussel rearing don't end with a juvenile mussel. Because of their complex life cycle and minute sizes, raising mussels in captivity is not as easy as placing them in a container with food, water and shelter. Their is no friendly manual in pet stores for these creatures. Therefore, our first step to rear mussels in the laboratory was to develop a diet suitable for growth and survival of baby mussels. No previous studies had tested possible diets for young mussels, so a graduate student project was designed to compare diets consisting of various species of algae, as well as an artificial diet similar to what is fed to larval fish, shrimp and marine clams.

Juvenile mussels first were obtained from host fishes and readied for use in laboratory experiments. Various species of algae



Raising mussels outside of their natural environment is not easy, but may be essential to their future survival. Researchers at VA Tech are refining their techniques of mussel culture, hoping to become successful enough to save these threatened species from extinction. Mussel cages suspended in farm ponds are being tested as possible holding and spawning devices for endangered adult mussels (below) and as rearing pens for juveniles (bottom).



Richard Neves



Richard Neves

were cultured in the laboratory, compared in nutritional value, and combined to provide what we felt would be a balanced diet. We also tested various culture methods in terms of water flow and presence or absence of sediment. Groups of juveniles were fed these different diets daily, and their survival and growth was monitored over 45 days to determine which diet performed best. After experimenting with numerous diets for two years, our best success was achieved using a diet of three species of algae.

Testing by early researchers indicated that young mussels need a habitat which includes fine sediment to survive. Therefore we ran experiments with and without sediment to compare survival. In examining the guts of these juvenile mussels, it was readily apparent that, in addition to algae, they indeed ingest fine silt and the bacteria colonizing that sediment.

Young mussels require several months to develop their feeding structures, so their method of feeding as baby mussels is different from the well-developed filter-feeding apparatus of adults. The ingestion of minute particles by young mussels is accomplished by a combination of water currents created by the beating of minute hairs (cilia) and the passage of food particles moving along the cilia toward the mouth. The ingestion of fine sediment

and the bacteria growing on it appears to be important to young mussels. Could bacteria be serving as an important source of nutrition for them? Further testing hopefully will answer this question.

With these pieces of the research puzzle, can we upscale the experiment to make it practical for the production of juveniles of rare mussel species in Virginia and elsewhere? Using the algae diet which gave us the best results, we are now planning to expand our culture efforts to a scale large enough to be commer-

outdoors. A farm pond at Virginia Tech is being used to float containers with fine-mesh screen on the bottom. Sediment has been placed in these containers along with several hundred juvenile mussels. The containers, connected to a flotation collar, are submerged below the surface and exposed to the natural plankton blooms in the pond. We are evaluating the survival and growth of these juveniles with those reared in the laboratory.

Other rearing experiments are being conducted in a fiberglass stream channel at the Clinch River Steam Plant in Carbo, VA. Water from the Clinch River with natural algae is pumped through the channel into troughs which contain sediment and juvenile mussels. For unknown reasons, mussels in the Clinch and Powell rivers do not seem to be reproducing, and use of this stream channel may be the best method to sustain declining species until explanations for their reproductive failure can be provided. Using species native to the river, we hope to determine whether this channel can be used to produce thousands of juvenile mussels for release to the river.

We stand at an important crossroad for freshwater mussels and

many other aquatic invertebrates. If Virginia's rare and endangered mollusks are to survive into the next century, then some significant breakthroughs in artificial propagation as well as improvements in riverine environments will be required. Unless we can identify and correct problems with the quality of habitat in our rivers, and prevent exotic species such as the dreaded zebra mussel from entering our waterways, then we fight a losing battle in the war against species attrition.

Mussels are just the tip of the iceberg; the most sensitive monitors of water quality and thus the first to disappear. If we fail to preserve these species, then the prognosis for other animals in our waters will not be bright. For the survival of Virginia's endangered mussel species, the production and culture of young mussels is a critical step to avoid the wholesale extinction of these small but colorful members of our aquatic fauna. □

Dr. Richard Neves is the Unit Leader of the Virginia Cooperative Fish and Wildlife Research Unit at VA Tech and is a scientist with the new National Biological Survey. He specializes in aquatic mollusks and endangered species.



Above and page 10: For unknown reasons, the freshwater mussels in the Clinch River in southwest VA do not seem to be reproducing, and safe holding areas along with the artificial culture of mussels may be a way to sustain declining species until we can ensure their health and survival in the wild; photos by Tim Wright and Lynda Richardson.

cially practical. In place of the one and five gallon tanks used previously, we are in the process of setting up a culture facility that will include 50 and 100 gallon tanks and troughs with recirculating water. To obtain sufficient algae to feed our expected baby mussels, larger tanks will be used to raise algae for them. The Aquaculture Center at Virginia Tech is expanding to include a new wing for mussel culture, to accommodate the space and facility needs of this new venture.

In addition to the expanding research with mussel culture in the laboratory, we are testing the feasibility of culturing young mussels







Swimming Beyond Boundaries

The Uncertain Future of Virginia's Marine Mammals and Sea Turtles

by Sue Bruenderman and
Karen Terwilliger, VDGIF
Nongame and Endangered
Wildlife Program

Introduction:

As much as we'd like to claim them as our own, the animals of our salt waters do not recognize boundaries. They may arrive in Virginia for the summer to nest and lay their eggs, or they may stop to feed and rest in the Chesapeake Bay while traveling the world's coastlines from Africa to Iceland. But it isn't long before they are on their way again.

For millions of years, sea turtles and marine mammals (the whales, dolphins, seals, and manatees) have traveled through or frequented Virginia's waters. Whether they stop in Virginia for a day, a week, or a few months a year, the Chesapeake Bay and coastal waters of the Commonwealth are essential to their survival. These animals depend upon the oceans of the world for their existence; each stop in their travels is as important as the next in their journeys across the seas.

Since the 16th century, however, sea turtles and marine mammals have been threatened by humans. Prized for their meat and eggs and the fine products from their blubber, shells, and other body parts, they suffered relentless and unregulated commercial harvest. Today, we are no longer dependent on their fur and oil to keep us alive, and the commercial exploitation of marine mammals is coming to a close. Once we had these animals to thank for our own survival through a harsh winter or a dark, cold night; today, in an ironic twist of fate, these creatures are now completely dependent upon us for their existence.

Though we may never come close to Virginia's coastline, we are intimately connected to these magnificent sea creatures. Everything we do, every toxic substance that drains from our houses or from our lands, is carried into a body of water. One stream dissolves into the next, and the final quality of the water emptying into the seas is determined upstream. Every little stream and creek in Virginia, whether its origin is in the mountains or the

C. Roden, NOAA/NMFS



Lynda Richardson



piedmont or coastal plain, ultimately makes its way to an ocean.

Because of this, and because sea turtles and marine mammals are found in all oceans of the world, we all affect the quality of their life source—the aquatic environment.

In the following pages, we'll illustrate the efforts being taken in Virginia to help save marine mammals and sea turtles. We will look at some of these species in detail so you, too, can become familiar with these animals. We'll introduce you to the various scientists and their programs which are aimed at gaining insight into the mysterious biology and

Top: Striped dolphins are rare visitors to VA waters, and like other marine mammals and sea turtles, are often the unfortunate victims of fatal entanglement in commercial fishing gear. Above: Loggerhead sea turtles spend their first 1-3 years sheltered in mats of Sargassum sea grass in the Gulf Stream, struggling to survive to a still perilous adulthood, when the threats to their existence come exclusively from humans.

ecology of these animals. And we'll examine both past and present threats to sea turtles and marine mammals, to help you to better understand how our own actions affect them. Finally, we'll tell you how you can join in the effort to preserve these special marine creatures.

Virginia's Marine Mammals

There are some 75 species of whales and dolphins, and they are categorized into two groups: the *baleen* whales (suborder Mysticeti—the *right, blue whale, fin, sei, minke and humpback whales*) and the *toothed* whales (suborder Odontoceti), which includes all other *whales, porpoises and dolphins*.

Twenty-five of these species have been sighted in Virginia waters. In addition, *gray seals, harbor seals, harp seals and hooded seals*, (order Pinnipedia), and the *West Indian manatee* (order Sirenia) wander into VA.

Below is a list of the species which have been sighted at sea or stranded upon our beaches:

Harbor porpoise
Atlantic bottlenose dolphin
Striped dolphin
Saddleback dolphin
Atlantic spotted dolphin
Atlantic white-sided dolphin
Risso's dolphin
Rough-toothed dolphin
Short-finned and long-finned pilot whales
Pygmy sperm whale
Dwarf sperm whale
Sperm whale
Fin whale
Minke whale
Humpback whale
Northern right whale
Goosebeaked, Dense-beaked, Antillean beaked, Gervais' beaked, True's beaked whales
Blue, Sei, Bryde's whales
West Indian manatee
Gray seal
Harbor seal
Harp seal
Hooded seal

The Animals:

Following are descriptions of some of the more commonly stranded or sometimes observed marine mammals known from Virginia's coastal waters. *These accounts are excerpted and adapted from S. Leatherwood and R. Reeves, The Sierra Club Handbook of Whales and Dolphins (1983) reprinted with permission from Sierra Club Books, 100 Bush Street, San Francisco, CA 94104, and "Marine Mammals of Virginia" by Robert A. Blaylock, VIMS (July 1985). Other sources include: Virginia's Endangered Species, McDonald & Woodward Publishing, Blacksburg, VA (1991) and A Field Guide to Whales, Porpoises, & Seals from Cape Cod to Newfoundland, by Steven K. Katona, et. al., 4th ed. revised, Smithsonian Institution Press, Washington, DC (1993).*

Atlantic bottlenose dolphin

Tursiops truncatus

Maximum length: 12 ft.

Life span: 25-35 yrs.

Sexual maturity: 5-13 yrs.

Food: Croakers, sea trout, spot, menhaden, hake and squid.

Range: Cosmopolitan; absent only from polar regions. Atlantic Ocean from Nova Scotia and Norway to Patagonia and the tip of South Africa; fairly common in the Mediterranean Sea.

Status: Widely distributed and abundant, but

subject to threats in areas.

Identification: The bottlenose is slate gray dorsally, shading to white ventrally. Its short, stubby beak distinguishes it from most other dolphins in Virginia's waters.

Remarks: The inshore form of this species is the most abundant marine mammal along Virginia's coast and can be observed within one mile of shore, and in the Chesapeake Bay and its tributaries from late spring into the winter. It is listed as threatened under the Marine Mammal Protection Act. The larger, offshore type is encountered along the 100-fathom line. Attracted to human activities, this dolphin eats discarded fish or fish stirred



Atlantic bottlenose dolphin
Tursiops truncatus



preferred food

Saddleback (Common) dolphin

Delphinus delphis

Maximum length: 8.5 ft.

Life span: 25-30 yrs.

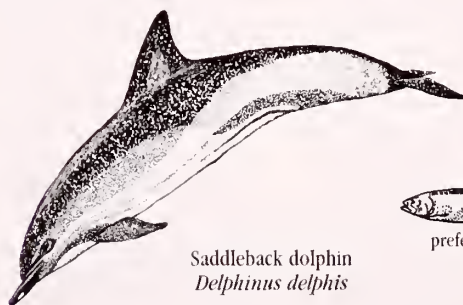
Sexual maturity: 3-4 yrs.

Food: Fish such as anchovies and hake.

Range: All tropical, warm temperate oceans. In the North Atlantic, saddleback dolphins may be found in temperate through tropical waters from Newfoundland to Venezuela.

Status: Widely distributed, but declining in the Black Sea and eastern tropical Pacific.

Identification: The body shape of the saddleback is similar to that of the striped dolphin. The dorsal fin may be nearly tri-



Saddleback dolphin
Delphinus delphis



preferred food

up by nets and propeller washes. For more information, refer to J.G. Mead and C.W. Potter's "Natural history of bottlenose dolphins along the central Atlantic coast of the U.S." in *Bottlenose Dolphin*, Academic Press, Inc., N.Y. (1990).

angular or curved and is usually entirely black, although it may have a grayish patch in the middle. The species' common name comes from an hourglass pattern on the flanks.

Remarks: Fairly common off Virginia's coast, this is

among the most gregarious of cetaceans. They travel in herds of several hundred.

Striped dolphin
Stenella coeruleoalba



Striped dolphin
Stenella coeruleoalba



preferred food

Maximum length: 9 ft.
Life span: Unknown.
Sexual maturity: 5-9 yrs.
Food: Small fishes, squid, shrimp.
Range: Widely distributed across all temperate, subtropical and tropical seas. In the eastern North Atlantic from Nova Scotia to Jamaica.
Status: Unknown.
Identification: The striped dolphin is dark gray to light gray dorsally, gray on the sides and white ventrally. Its common name is derived from the black lateral

stripes, one extending from its eye to flipper, and the other from its eye to the anus. It has a V-shaped "shoulder blaze," originating from behind the eye and narrowing to

a point below and behind the dorsal fin.
Remarks: Little is known about the striped dolphin in VA waters. It is pelagic, usually found in and around the Gulf Stream. In the 1960's, an extremely rare herd of striped dolphins was sighted near the mouth of the Chesapeake Bay.

Harbor porpoise
Phocoena phocoena

Maximum length: 5 ft.
Life span: 10-15 years.
Sexual maturity: 3.2-6 yrs.

Food: Shad, anchovies, and other fish.

Range: Colder, northern waters, ranging

from Greenland and the Davis Straits in the north, south to North Carolina.
Status: Widely distributed and locally abundant, but some evidence of decline in the North, Baltic

tions, *Phocoena phocoena* is the only true porpoise found in the North Atlantic. Its occurrence in VA is seasonal, coinciding with the spring shad run. Harbor porpoises travel



Harbor porpoise
Phocoena phocoena



preferred food



Pygmy sperm whale
Kogia breviceps
mammal illustrations by Sally Austin



preferred food

and Black Seas. North Atlantic populations are coming under severe fishing pressures as well. There is a proposal to list the western north Atlantic stock as threatened.
Identification: The harbor porpoise's small, spade-shaped teeth and small triangular-shaped dorsal fin differentiates it from dolphins, which have conical teeth and a curved fin. It has a small and chunky body, small head and lacks a beak. Coloration is dark brown, black or dark gray dorsally, shading to lighter gray on the sides and white to gray ventrally.
Remarks: Known as the "puffing pig" in Canada and New England for the soft "puffing" sound of its exhalation.

in small groups of one to 10, and being timid, they are not easily approached. Accidental entanglement in fishing gear is a major cause of mortality.

Pygmy sperm whale
Kogia breviceps

Maximum length: 11 ft. or more.

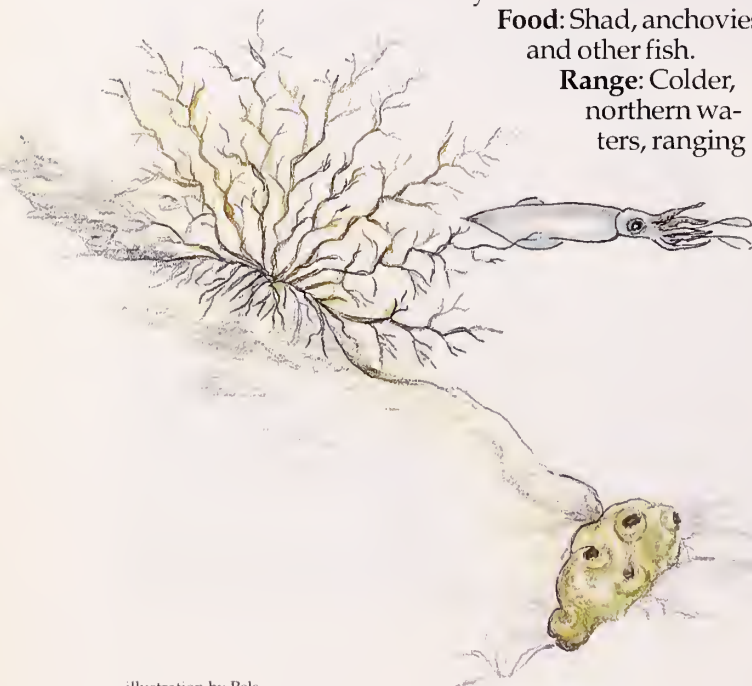
Life span: Unknown.

Size at sexual maturity: Lengths: 8.6-10 ft.

Food: Squid, octopus, crabs, shrimp and fish.

Range: With information based almost entirely from strandings, they appear to occur in most temperate, subtropical waters. In the North Atlantic, from Nova Scotia to Cuba.

Status: Though not con-

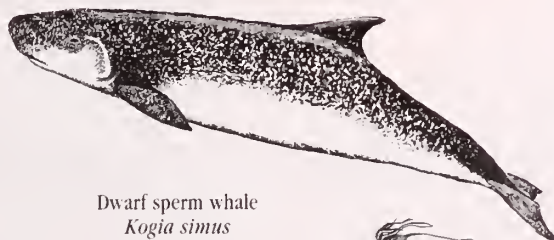


sidered an endangered species, they are considered uncommon.

Identification: With a robust body which tapers near the tail, the head is shark-like in shape, and is pointed when viewed

in pairs. At rest they may remain motionless at the surface with their snouts barely visible.

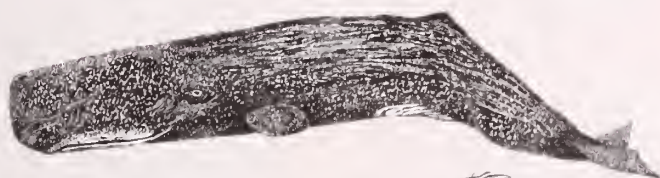
Dwarf sperm whale *Kogia simus*



Dwarf sperm whale
Kogia simus



preferred food



Sperm whale
Physeter catodon



preferred food



So little is known about most marine mammals, and unfortunately, most of the information we have gained comes from strandings of dead and live animals like the pygmy sperm whale above.

from above. Bracket-shaped markings, or "false gills" are located on either side of the head. Beached specimens can be misidentified as sharks.

Remarks: This is the most frequently live-stranded cetacean in this area. They appear to travel singly or

Maximum length: 9 ft.
Life span: Unknown.
Size at sexual maturity: Lengths of 7 ft.

Food: Squid, fish and crustaceans.

Range: Along the East Coast, it is known from VA (found stranded at Wachapreague) south to the Lesser Antilles.

Status: Uncertain.

Identification: Similar in appearance to pygmy sperm whales in head

and body shape, and coloration. However, the tall, curved dorsal fin of the dwarf sperm whale is larger, and is positioned farther forward on the back.

Remarks: In September 1985, a dwarf sperm mother and calf were found stranded alive at Virginia Beach. The apparently diseased mother died in transport to the laboratory. The calf, the first dwarf sperm whale kept alive in captivity, was bottle-fed at the VA Marine Science Museum.

Sperm whale *Physeter catodon*

Maximum length: 69 ft.

Life span: Unknown.

Sexual maturity: 9-13 yrs.

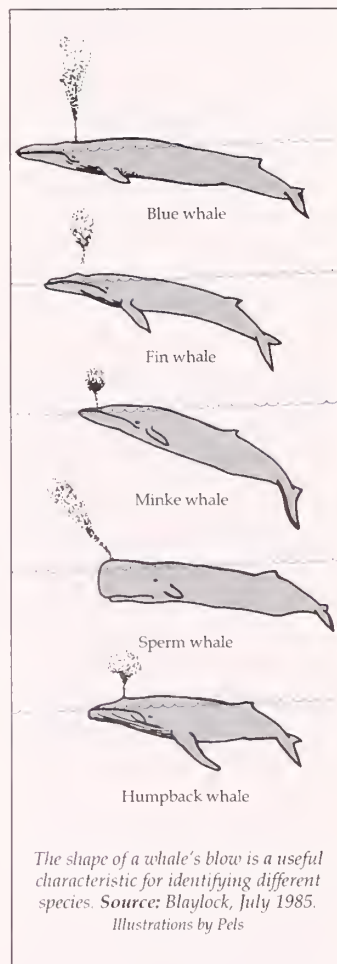
Food: Squid, octopus, fish.

Range: All oceans of the world. In the North Atlantic, from the Davis Straits in the north; south to Venezuela.

Status: Federally endangered.

Identification: The infamous "Moby Dick" is the largest of the toothed whales. The massive, blunt head is one-third of the whale's total body length. Identification of this whale is usually by its single nostril located on the left side of the midline of the head, and the 15 ft. tall spout. A dorsal hump is followed by a series of bony knuckles, visible when the animal dives. The skin is dark brownish-gray and has a wrinkled appearance. **Remarks:** The sperm whale is a deep diver, and can stay submerged for an hour or more. They have been recovered entangled in overseas telephone lines in depths ex-

ceeding 2,000 feet. To locate squid, sperm whales make loud sonar clicks which sound like the banging of a carpenter's hammer. In VA, sperm whales may be encountered near the 100-fathom



The shape of a whale's blow is a useful characteristic for identifying different species. **Source:** Blaylock, July 1985. Illustrations by Pels

line offshore either alone or in pods of up to 40 individuals.

Minke whale

Balaenoptera acutorostrata

Maximum length: 30 ft.

Life span: 50 yrs.

Sexual maturity: 4 yrs.

Food: Fish, squid, krill.

Range: In the North Atlantic, they are found in polar, temperate, and tropical waters. Also found from the northern pack ice south to the Lesser Antilles and the Gulf of Mexico.

Status: An estimated 2,000 minke whales inhabit the continental shelf waters from Cape Hatteras to Canada.

Identification: The smallest baleen whale in the northern hemisphere, minkes have a very narrow, pointed rostrum (snout) with a single medial ridge. The dorsal fin is tall and curved. Its color is black to dark gray on the back and white underneath, with a broad white stripe across each flipper. The fine-bristled baleen are short and creamy white, but are usually visible only on stranded minkes.

Remarks: Minkes usually swim alone, in pairs or as trios. They will sometimes accompany a moving vessel for miles. They are difficult to sight at sea, however, because of their low, inconspicuous blow. Minkes are acrobatic, often exhibiting breaching behavior and sometimes leaping clear out of the water.

Fin whale

Balaenoptera physalus

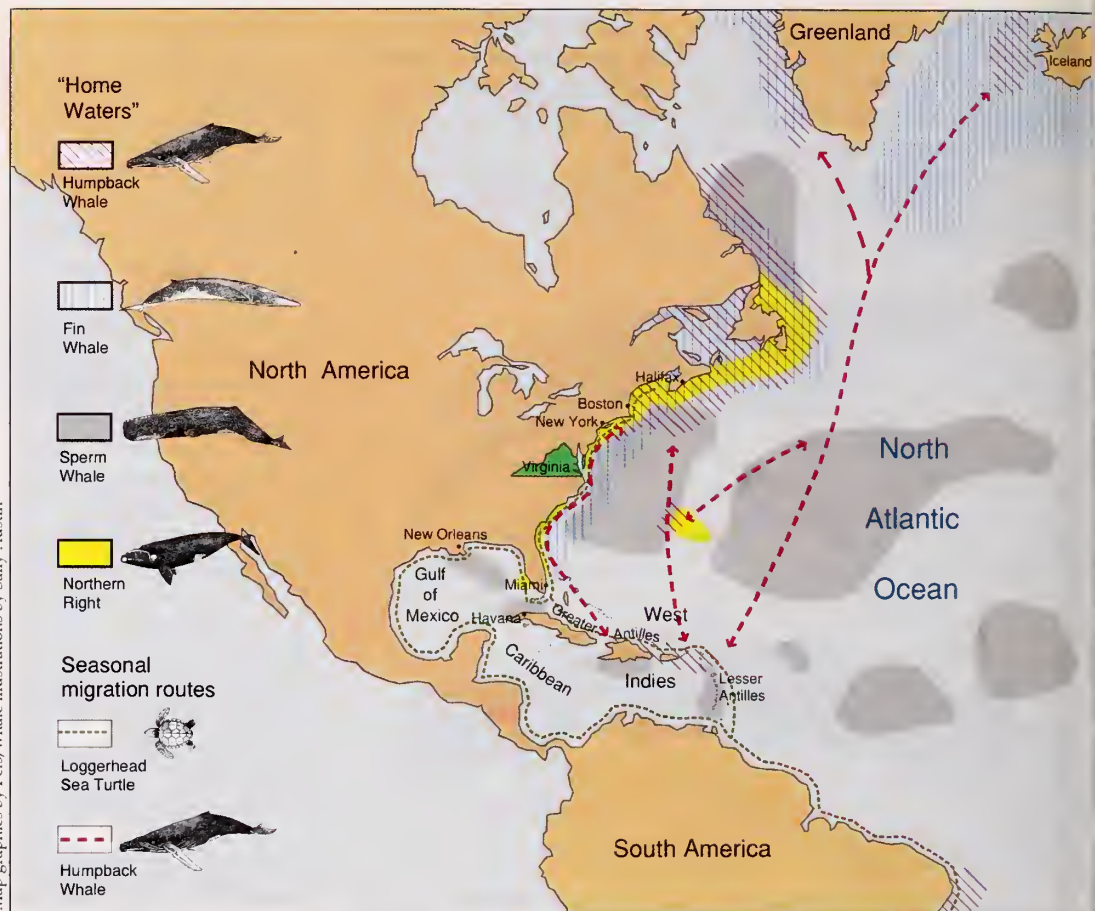
Maximum length: 79 ft.

Life span: 90 yrs.

Sexual maturity: 5-6 yrs.

Food: Capelin, squid, lanternfish, krill.

Range: Worldwide. Western North Atlantic fin whales are migratory, moving into the high lati-



Most marine mammals and sea turtles travel extensive distances in all oceans of the world when migrating between feeding and breeding grounds. Represented in this illustration are the western North Atlantic seasonal migration paths of two of the most common of these animals frequenting our waters: humpback whales (arrows) and the loggerhead sea turtles (dashes). The shaded areas represent the range of the large whales in the western North Atlantic. (References: National Geographic Magazine, December 1976, and Kenneth C. Dodd, Jr. 1990. *Caretta Cat. Amer. Amphib. Rept.* 482.1 to 483.7.)

tudes in spring and summer and south to Florida and the Greater Antilles and into the Gulf of Mexico during the winter, primarily in offshore waters. **Status:** Federally endangered.

Identification: The fin whale gets its common name from its prominent dorsal fin, which may

reach 24 inches in height. Its blow is from 15 to 20 feet and shaped like an inverted cone. The dorsal fin, along with its brownish-black to gray dorsal and white ventral coloration, distinguishes it from its larger cousin, the blue whale. The back has a distinct ridge from the dorsal fin to the flukes,

hence the common name "razorback." The right front baleen are yellowish-white, and the remainder of the baleen are alternating bands of yellowish-white and gray. **Remarks:** The graceful fin whale has long been considered one of the fastest of all marine mammals. A 75-ft.-long fin



Minke whale
Balaenoptera acutorostrata



Fin whale
Balaenoptera physalus

whale can dive as deep as 755 ft., and swim at speeds up to 25 miles per hour. Fin whales have been found stranded in Virginia and are probably the most abundant large whales in our waters. Fin whales apparently sleep on the surface at night, and thus are subject to collisions with ships. One fin whale was brought into Norfolk Harbor draped across the bow of a freighter, and several have been found with broken jaws, suggesting collisions with ships.

Short-finned and long-finned pilot whales

Globicephala macrorhynchus and *G. melaena*

Maximum length: 20 ft. and 17.5 ft.

Life span: 25-50 yrs.

Sexual maturity: 6-13 yrs.

Food: Squid and fish.

Range: *Long-finned pilot whale:* in the North Atlantic, it occurs from Cape Hatteras north to Iceland and Greenland. *Short-finned pilot whale:* Cosmopolitan, more tropical distribution than long-finned. In the Atlantic, its normal range extends from VA south to Venezuela.

Status: Abundant in places, widely distributed.

Identification: Both species are black except for a few gray markings on the ventral side. They have a prominent, curved dorsal fin, and their flippers are long and sickle-shaped with a thickly keeled tail. The two species look very similar and can be positively identified only by dissection.

Remarks: Both species



Short-finned pilot whale
Globicephala macrorhynchus



Long-finned pilot whale
Globicephala melaena

occasionally are found near the edge of the continental shelf off VA. They usually occur in herds of 60 or less, although herds of up to 200 animals have been reported for the long-finned pilot whale. Frequently seen lobbing their tails, "spyhopping" (popping their heads out of the water), and basking at the surface, their daily activity patterns and seasonal movements appear to be related to the movements of squid populations.

Humpback whale

Megaptera novaeangliae

Maximum length: 53 ft.

Life span: Unknown.

Sexual maturity: 4-6 yrs.

Food: Krill and fish.

Range: In the North Atlantic, humpbacks range from north of Iceland to the West Indies. They normally spend their summers in northern feeding grounds, and in winter, migrate through VA to warmer Caribbean waters for calving and

breeding. During the past three years, several humpbacks have spent the winter off the Virginia coast. Read W. M.

Swingle, et. al. paper in the 1993 *Marine Mammal Science* 9(3):309-315 entitled "Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia" for details.

Status: Federally endangered.

Identification: This robust whale has a broad rounded head with a string of fleshy knobs taking the place of the ridge common to most other whales in the family Balenidae. Its white flip-

pers are very long, and scalloped and knobby on the leading edge. The rest of its body is mostly black, with white areas of varying shape and size on the belly.

Remarks: Humpbacks are notorious both for their unique "bubble-net" feeding behavior and for their melodious sounds produced on breeding and calving grounds. They are subject to entanglements in fishing gear, like gill nets.

Northern right whale

Eubalaena glacialis

Maximum length: 53 ft.

Life span: Unknown.

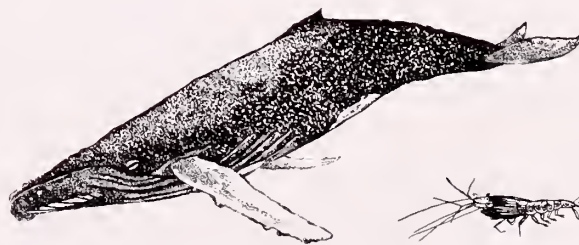
Sexual maturity: 7-10 yrs.

Food: Copepods and other small planktonic crustaceans, krill.

Range: In the North Atlantic, right whales are found in waters off Iceland, Nova Scotia and New England in the spring and summer. They migrate south to breed and calve in winter. Calving grounds have recently been discovered along the Georgia coast and right whales migrate past VA in the spring and fall.

Status: Federally endangered. Probably less than 400 remain alive in the western North Atlantic.

Identification: Lacking a dorsal fin or ridge, the



Humpback whale
Megaptera novaeangliae

first clue to this rotund whale's identity from a distance is its low and bushy spout. Often dark brown or mottled on top. A distinguishing feature is the presence of "callosities" or patches of a yellowish-white horny material in front of its blow holes. It has a high, arching upper jaw, with long, dark, slender baleen.

Remarks: Of the 286 catalogued right whales, over 50% bear scars on their bodies from entanglement with nets or ropes.

Harbor seal
Phoca vitulina

Maximum length: 5.9 ft.

Life span: 30-35 yrs.

Sexual maturity: 3-6 yrs.

Food: Mostly fish and invertebrates, including herring, squid, alewife, flounder, whiting.

Range: In the Western North Atlantic Ocean, from the Arctic to Georgia.

Status: Populations appear to be recovering from bounty hunting which depleted stocks in New England and east-

William W. Hartley



Harbor seals are infrequent visitors to VA waters, and have been sighted in the Chesapeake Bay and the James River.

ern Canada.

Identification: A medium-sized seal with a brown coat and varying small dark spots or mottling. No externally visible ears.



Northern right whale
Eubalaena glacialis

Remarks: Harbor seals normally bask and sleep during low tides on coastal islands and ledges, and forage during high tides. In VA, an occasional seal hauls out at VA Beach, in Linkhorn Bay, and even at Hopewell on the James River. They are not exclusively marine, and infrequently, small groups of harbor seals may be found near the islands of the Chesapeake Bay Bridge Tunnel in spring and summer.

West Indian (Florida) manatee

Trichechus manatus

Maximum length: 13.1 ft.

Life span: Unknown.

Sexual maturity: Unknown.

Food: Submerged aquatic vegetation.

Range: Georgia, Florida and the Gulf of Mexico, and as far south as Cuba and the West Indies. Occa-

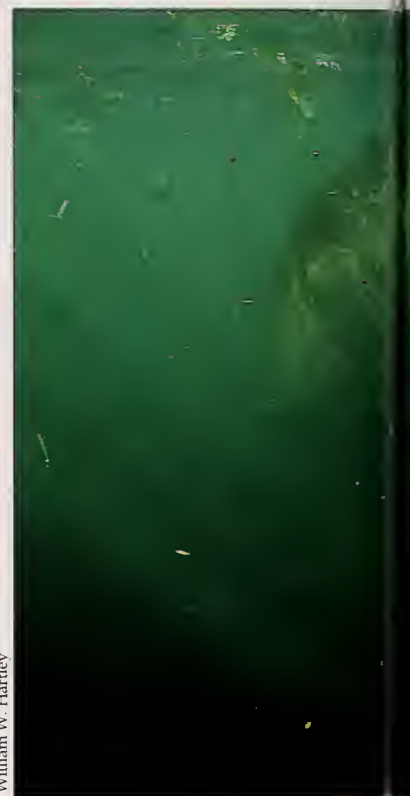
sionally trav-

els northward through the Carolinas and into VA.

Status: Federally endangered.

Identification: This unusual mammal has thick, elephant-like skin and paddle-like flippers with rudimentary nails. It is gray in coloration and al-

William W. Hartley



most hairless. Its under-slung jaw is hidden by two large fleshy lips which overhang it on each side.

Remarks: Manatees inhabit coastal areas, rivers and creeks. In their normal range, they congregate in large numbers near the warmwater discharges of industrial plants. Because they are slow swimmers and inhabit waters near large human population centers, manatees are susceptible to injury and death from collisions

illustration by Pels



preferred food

Harbor seal
Phoca vitulina



preferred food

West Indian manatee
Trichechus manatus

marine mammal illustrations by Sally Austin



Sightings of West Indian manatees have been on the increase in VA during the past 10 years. Because they are slow swimmers and inhabit coastal areas, rivers, and creeks, they are particularly susceptible to injury and death from collision with boat propellers.

with power boat propellers. They often get caught in flood gates and can drown. Sightings of manatees in VA's waters have been increasing during the past decade. Since 1980, one dead and seven live manatees have been recorded from various bays and rivers in VA.

Virginia's Sea Turtles

Of a total of 250 species of turtles found throughout the world, only 7 are sea-dwelling species. Five of these frequent Virginia's waters: Kemp's ridley, Atlantic hawksbill, loggerhead, Atlantic green and the leatherback sea turtle.

Unlike other aquatic and terrestrial turtles, sea turtles do not have retractable heads and feet. Except for the leatherback

which has no claws, sea turtles have fewer than three claws on each flipper.

The small diamond-back terrapin, *Malaclemys terrapin*, is sometimes mistaken for a sea turtle because it occurs in and throughout the Chesapeake Bay area and behind the barrier islands. Snapping turtles (*Chelydra serpentina*) are also often reported as sea turtles, since they occur in brackish and freshwater throughout VA. Should you encounter a turtle on an open ocean beach, check to see if it can disappear into its shell. If it can't and has paddle-like flippers, you'll know it's a sea turtle.

If you think you have found a sea turtle, dead or alive, call Virginia's Stranding Network at 804/642-7313 or 804/437-4961.

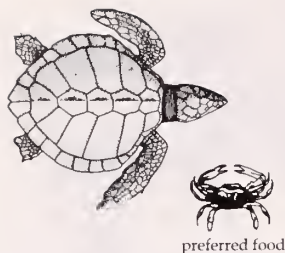
Following are the descriptions of the five sea turtles known to VA's waters. **Sources:** John A. Keinath and John A. Musick in *Virginia's Endangered Species* (1991) and *Decline of the Sea Turtles, Causes and Prevention*, National Research Council National Academy Press (1990).

Kemp's ridley sea turtle
Lepidochelys kempii
Maximum carapace (top



Tom Brownold, marine mammal images

Leatherback sea turtles easily mistake plastics and other marine debris for jellyfish, their preferred food item, which can result in death.



Kemp's ridley sea turtle
Lepidochelys kempii

shell) length: 29½ inches.

Life span: Unknown, but probably more than 20 yrs.

Size at sexual maturity: 23-27½ inches.

Food: Blue crabs and other invertebrates.

Range: Gulf of Mexico, north along the East Coast of the U.S. to Massachusetts, and eastward to Bermuda, the Azores, and the Atlantic Coast of Europe. In VA, along the Atlantic Coast and throughout the lower Chesapeake Bay.

Status: Federally endangered.

Identification: This is the smallest of the sea turtles. The broadly oval-shaped shell of adults is charcoal gray to drab olive green above and white below. The head is large, with strongly ridged, powerful and massive jaws.

Remarks: This is the world's most endangered sea turtle, and probably the most mysterious. Only one major nesting beach, in Mexico, is known worldwide. Kemp's ridleys are found in shallow, near-shore sea grass beds where blue crabs are abundant. This rare turtle species normally occurs in VA's waters from May through November. Juveniles, numbering in the hun-

dreds, apparently use the Chesapeake Bay for summer foraging.

Atlantic hawksbill sea turtle

Eretmochelys imbricata imbricata

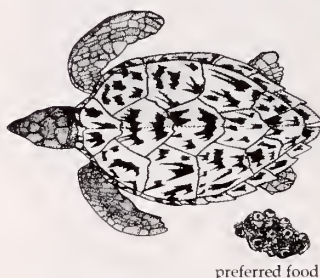
Max. carapace length: 36+ inches.

Life span: Unknown.

Size at sexual maturity: 30-35 inches.

Food: Sponges.

Range: Usually restricted to tropical oceans, but individuals have been found in the western Atlantic from southern



Atlantic hawksbill sea turtle
Eretmochelys imbricata imbricata

Brazil to New England.

Status: Federally endangered.

Identification: This is a small to medium sea turtle with an attractive amber, brown and black shell. The rear margin of its shell is strongly serrated, and the scales or "scutes" at this end of the shell overlap one another. The turtle has a distinct hawk-like beak.

Remarks: Hawksbill biology is poorly known. Apparently, they spend most of their time under the surface. Only one live specimen has ever been recorded from VA's waters. In 1990, a waterman clamming with patent tongs at the mouth of the James River incidentally captured one individual.



William W. Hartley



Lynda Richardson

Top: Atlantic green sea turtles are still harvested by some countries for turtle soup, and in the U.S. these turtles are threatened by poaching, entanglement in fishing gear, and propeller wounds.

Because maintenance dredging and sediment dumping can destroy nesting beaches, VA Tech researchers conducted a six-year study to identify the locations of critical sea turtle nesting areas in Florida. Discoveries like these help protect sea turtles worldwide (**above:** Loggerhead sea turtle laying eggs).

Loggerhead sea turtle
Caretta caretta

Max. carapace length: 48+ inches.

Life span: Unknown.

Age/size at sexual maturity: 20-30 yrs./31-35 in.

Food: Horseshoe crabs, crabs, mollusks, jellyfish.

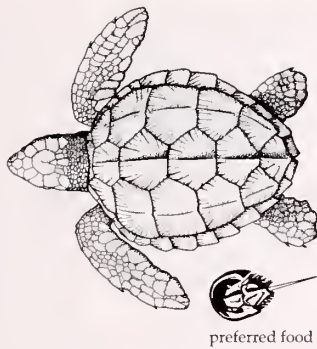
Range: Worldwide in tropical and temperate marine and estuarine waters. In the western Atlantic, they are found from Argentina north to Nova Scotia.

Status: Federally threatened.

Identification: This is the only reddish-brown sea turtle in VA's waters.

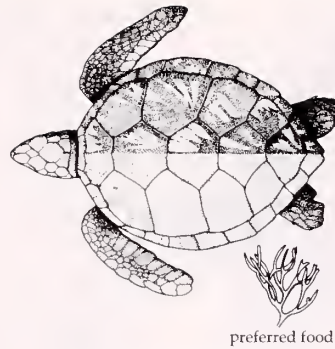
Cream-yellow underneath, its shell is usually encrusted with barnacles.

Remarks: Loggerheads are the most commonly observed sea turtle in VA. Along beaches in VA Beach and the Eastern



Loggerhead sea turtle
Caretta caretta

Shore, an average of three loggerhead sea turtle nests are found each year. Hatchlings, in a 2-3 day "swimming frenzy," leave the beaches to find food and refuge within floating mats of seagrass in the Gulf Stream. VIMS researchers have determined that the Chesapeake Bay serves as a major habitat for juvenile loggerheads—an estimated 9,000 seven to 15-year-old turtles spend their summers in the Bay. Here and elsewhere, loggerheads are vulnerable to commercial fishing practices, beach development, boat traffic, and pollution.



Atlantic green sea turtle
Chelonia mydas mydas

Atlantic green sea turtle
Chelonia mydas mydas

Max. carapace length: 60³/₈ inches.

Life span: Unknown.

Size at sexual maturity: 36-48 inches.

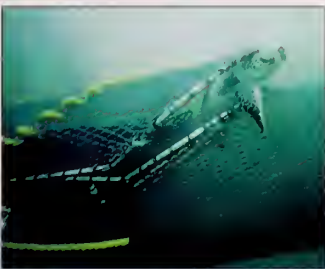
Food: Sea grasses and invertebrates.

Range: Throughout tropical oceans and estuaries. In the U.S. Atlantic waters, from the Virgin Islands and Puerto Rico and from Texas to Massachusetts.

Status: Federally endangered for Florida and east Pacific breeding populations. Threatened everywhere else.

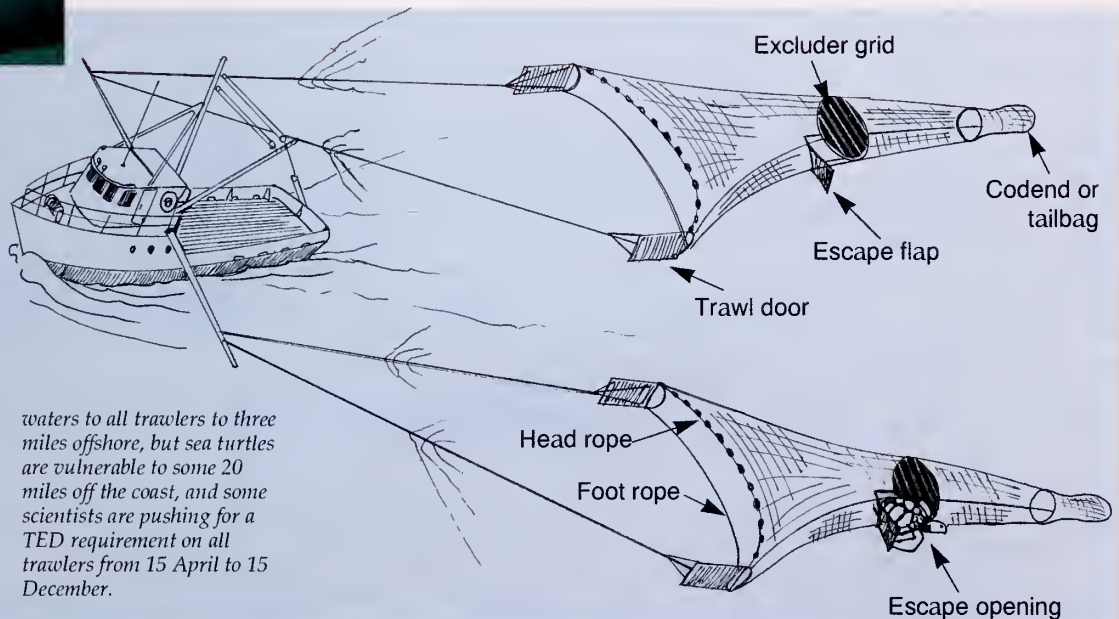
Identification: The largest hard-shelled sea turtle. Adults have a carapace varying in color from dark green to brown, often with bold streaks or spots. The underside of the shell and appendages are yellowish-white. Its small head and smooth carapace help distinguish it from VA's other four species.

Remarks: Rare in the Atlantic portion of their range, these turtles are extremely rare in VA. Green sea turtles are known here only as small juveniles. Areas from which they were found include the York and Potomac Rivers, the lower Chesapeake Bay, the Eastern Shore and VA Beach. It is not known if green sea turtles in VA's waters are vagrants or migrants. The extinction of many populations of green sea turtles can be linked to tropical and international markets for turtle soup. In the waters of the U.S., these turtles are poached for meat, wounded by boat pro-

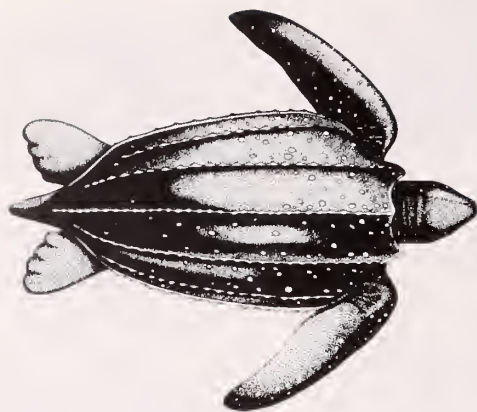


Above: A turtle excluder device (TED) in action.

TEDs (right: illustration of shrimp trawler towing two Georgia-type TEDs), which allow entrapped sea turtles to escape from the fishing nets of trawlers, are now required by NMFS on all shrimp trawlers in the Southeast, and have dramatically reduced the number of sea turtles becoming entrapped and drowning in their nets. Here, in VA, however, there is significant concern about the effect of the flounder trawler fishery on sea turtle mortality. In an admirable conservation effort, VMRC has already closed VA



waters to all trawlers to three miles offshore, but sea turtles are vulnerable to some 20 miles off the coast, and some scientists are pushing for a TED requirement on all trawlers from 15 April to 15 December.



Leatherback sea turtle
Dermochelys coriacea

sea turtle illustrations courtesy of NMFS



preferred food

pellers, or drown in fishing gear.

Leatherback sea turtle
Dermochelys coriacea

Max. carapace length:
74¼ inches.

Life span: Unknown.

Size at sexual maturity:
53-70 inches.

Food: Sea nettles, jellyfish.

Range: Throughout tropical and temperate oceans of the world. In the Western Atlantic Ocean, they occur from Argentina to Canada.

Status: Federally endangered.

Identification: The largest of all living sea turtles, its shell and body is covered with a continuous layer of smooth, black, delicate skin that feels and looks rubbery or leathery.

Remarks: Leatherbacks primarily forage in coastal and offshore waters, but occasionally wander close to shore and into estuaries. Leatherbacks venture into VA waters to feed, primarily from May to September. Many leatherbacks are observed on routine aerial surveys conducted by VIMS, especially at the mouth of the Chesapeake Bay. Dead leatherbacks washed up on VA's shores had propeller wounds, and constriction marks on their appendages, suggesting entanglement. Ingestion of plastics is likely an important mortality factor for leatherbacks, because they can easily mistake plastics for jellyfish.

Threats

For the world's sea turtles and marine mammals, their liquid environment has become as much of a threat to them as it has been the source of life—all because of man.

During the past 400 years, more than 2.5 million large whales were killed by commercial whalers. Blubber and

skin of the neck and upper forequarters was being used to replace alligator and crocodile hides for expensive shoes and women's handbags. Shields from the shells of freshly killed hawksbill turtles were transformed into jewelry and inlay work on toilet accessories and knife handles.

Large-scale harvest brought about the reduction of many populations



Lynda Richardson

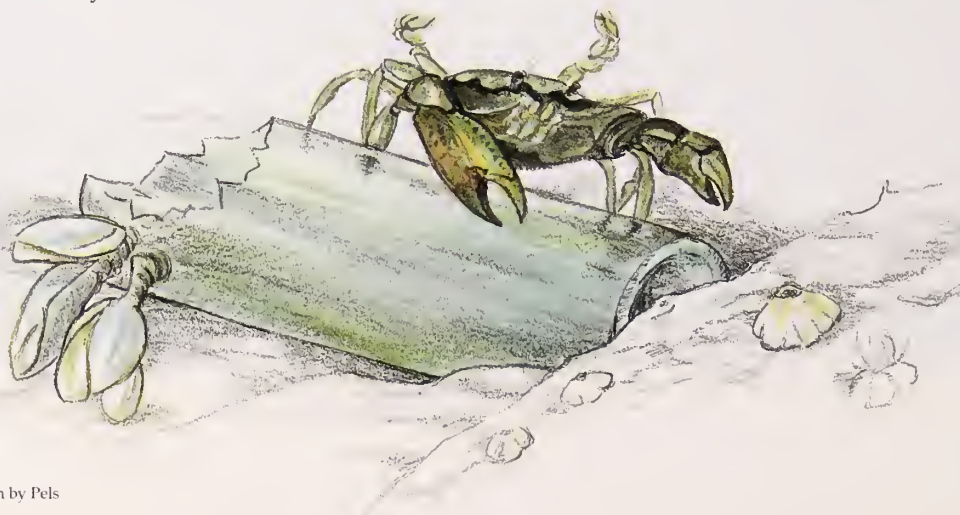
baleen of whales provided base materials for sewing machine oil, soap, corset stays, ramrods, fishing rods, and buggy whips.

In the early 1940's, green sea turtle oil was promoted as an ingredient in cosmetic lotions, and turtle leather from the

Above: Beachfront development threatens sea turtles by destroying nesting habitat and disorienting emerging young. The bright lights of development trigger hatchlings to tragically crawl or swim toward land instead of into the ocean.

Top right: Through VIMS satellite telemetry research, we now know that the Chesapeake Bay is a critical nursery ground for young loggerhead sea turtles.

of whales and sea turtles to dangerously low levels. Today, various legislative acts, such as the U.S. Endangered Species Act of 1973 and the Convention on International Trade in Endangered Species (CITES), have greatly reduced threats to sea turtles and large whales from commercial harvest.



Nevertheless, the sea turtle product trade continues. As recently as 1992, items made from green and hawksbill sea turtles were found for sale in shops in Vietnam: bracelets, eyeglass frames, fans, hairpins, combs, cigarette lighters, boxes and purses, necklaces and shoehorns. It is an extremely difficult task to manage species that migrate outside U.S. jurisdiction and are commercially exploited in other countries.

In addition, more recent problems threaten the survival of sea turtles and marine mammals, including:

development and renourishment projects, and navigational dredging;

• *Pollutants carried into the Chesapeake Bay and coastal waters from all across Virginia. The effects of "food-chain magnification" of toxins are realized worldwide, as rivers, winds, ocean currents and migrating marine animals carry these pollutants from sea to sea.*

Conservation Efforts

Worldwide, sea turtles and marine mammals face an uncertain future. In Virginia, researchers, volunteers and resource managers are

tions and other protective measures.

During the past several decades, a growing number of scientists in VA have been studying sea turtles and marine mammals in an attempt to unravel their mysterious life cycles, behavior, and other aspects of their biology and ecology. Similar to the animals which they study, scientists reach beyond Virginia's boundaries in their quest to answer these global questions.

In an attempt to bring their findings together and develop a comprehensive plan for the conservation and protection of sea turtles and ma-



Lynda Richardson



Lynda Richardson

- *Entrapment and entanglement in fishing gear;*
- *Fatal collisions with commercial and recreational boats;*
- *Sea turtle deaths from the ingestion of plastic "jellyfish-look-alikes" dumped overboard or washed into coastal waterways;*
- *Destruction of sea turtle nesting beaches and other habitats by beachfront*



Humpback whale; photo by Keith D. Mullin, NOAA/NMFS

Below left: Without human help, sea turtles have limited nesting success in VA. Thus, researchers patrol beaches from North Carolina to Cape Henry and relocate eggs to predator-proof areas in Back Bay National Wildlife Refuge to ensure nesting success.

Above: Well-meaning boaters need to be aware that their actions can disturb marine mammals and alter their natural behavior. Consideration and caution is advised when encountering these wild animals.

doing their very best to brighten this bleak picture.

Four regulatory agencies share jurisdiction and responsibility for these animals: the VA Department of Game and Inland Fisheries (VDGIF) and the VA Marine Resources Commission (VMRC) on the state level, and the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) on the federal level. All four agencies provide manpower and money for critical research and stranding programs, direction for conservation efforts, and develop and enforce regula-

tions and other protective measures. During the past several decades, a growing number of scientists in VA have been studying sea turtles and marine mammals in an attempt to unravel their mysterious life cycles, behavior, and other aspects of their biology and ecology. Similar to the animals which they study, scientists reach beyond Virginia's boundaries in their quest to answer these global questions. In an attempt to bring their findings together and develop a comprehensive plan for the conservation and protection of sea turtles and ma-

mendations for the conservation of these animals in VA. In addition, educational materials (including this publication) and a video for the general public are planned.

In the cooperative spirit of this effort, therefore, Virginia's biologists give brief overviews of their current research, educational and conservation programs below:

Virginia Institute of Marine Science (VIMS)

John A. Musick, John A. Keinath, Debra E. Barnard
School of Marine Science
Gloucester Point, VA

Sea Turtle and Marine Mammal Program

For the past 15 years, Dr. Musick and his colleagues have made significant contributions to our knowledge of sea turtles and other marine animals swimming off VA's coast. One of the most important missions of this program has been the use of aerial surveys to determine relative abundance and seasonal distribution of these animals found in Chesapeake Bay and coastal waters. Because sea turtles may take up to 30 years to mature, VIMS' census of 6 to 12-year-old juvenile turtles may be the best indicator of the success or failure of conservation efforts on nesting beaches to the south of us. Aerial surveys also allow us to follow migratory routes and track abundance, helping us to determine whether turtle and mammal populations are increasing or decreasing.

VIMS' past studies of sea turtles and marine mammals have provided information on sea turtle food habits, seasonal turtle pathways and overwintering areas. They have also verified estimates of turtle growth rates and ages at maturity in the first such successful study on a wild population of sea turtles in the world.

Virginia Tech

Michael R. Vaughan, Virginia Cooperative Fish and Wildlife Research Unit, National Biological Survey
Department of Fisheries and Wildlife Sciences, Blacksburg, VA



Michael Vaughan

Hawksbill sea turtles are extremely difficult to track by satellite since they only surface for 15 minutes every 24 hours. Nevertheless, researchers at VA Tech succeeded in determining that these rare turtles make long-range journeys, thus dispelling a long-held myth by countries insisting that they harvest only "local" sea turtles for "tortoise shell."



Lynda Richardson

Sea Turtle Research—Loggerheads, Atlantic Greens and Atlantic Hawksbills

The research being conducted by Dr. Vaughan and his students addresses threats which are common to sea turtles in the coastal areas of Virginia and elsewhere. The purpose of their six-year-study on the coast of Florida was to determine the importance of a 7 to 8-mile stretch of beach to sea turtle nesting. Considered as a possible addition to the Archie Carr National Wildlife Refuge, Dr. Vaughan's research provided important information needed for the acquisition of this beach for sea turtles. After measuring nesting effort and nesting and hatching success for loggerheads and green sea turtles, they verified that this

beach and the Melbourne Beach just north of it, have the second highest concentration of loggerhead sea turtles in the world.

In a separate study in St. Croix, Dr. Vaughan and student Erica Groshens studied seasonal movements of hawksbill sea turtles. Scientists have been reporting conflicting evidence on whether hawksbills are migratory or exist as local populations. Satellite telemetry was used to measure hawksbill movements. The study was particularly important because hawksbills, probably the second most endangered species

Above: Predators from ants to jaguars prey on sea turtles nests throughout the world. Here in the U.S., raccoons have been known to destroy up to 85% of sea turtle nests, primarily because predator numbers have increased with human development.

of sea turtles, are still legally harvested for "tortoise shell." Cuba, for example, assumes hawksbills are not migratory, arguing that all the turtles they harvest are from Cuba. Dr. Vaughan and Erica determined this not to be true, showing that hawksbills make long-range movements immediately after laying the final nest of the season. Great effort was expended in obtaining this piece of information, because hawksbills spend less than 15 minutes per 24-hour period on the surface of the water, and thus are extremely difficult to track by satellite.

U.S. Fish and Wildlife Service, U.S. Corps of Engineers, VIMS, and City of Virginia Beach
William Hester/Kathy Owen (USFWS)

Loggerhead Sea Turtle Management

Federal, state, and local agencies and institutions combined efforts in 1993 in hopes of improving the outlook for federally threatened loggerhead sea turtles in VA. With funding from the Corps, the USFWS Back Bay National Wildlife Refuge expanded its turtle nest patrol to cover a majority of the beach from the

crease the population of nesting loggerhead turtles on VA's beaches.

Loggerhead Sea Turtle Study

Loggerhead females may nest several times during the summer. To determine the activities of nesting loggerhead females between nesting attempts, the USFWS, Corps, and VIMS are placing radio transmitters on nesting female loggerheads. The transmitters relay signals to computers at VIMS by satellite and provide exact locations of the turtles throughout the day. The results of 1993's efforts are not yet

ples from dead animals are sent to appropriate agencies such as the Smithsonian Institution Marine Mammal Research Program or the VIMS Sea Turtle Program.

Although it is an unfortunate circumstance for the animals, dead carcasses often are the principal means by which scientists unravel biological truths about these strange and wonderful creatures.

Operation Dolphin

Utilizing small boat surveys, shore-based surveys and photographic identification (photo-ID), researchers have begun to characterize the distribution, movements and population status of VA's coastal bottlenose dolphins. More than 250 individual dolphins have been cataloged and comparisons with information collected in other states may provide insight into their migration patterns.

Humpback whale research

Researchers have documented a dramatic increase in humpback whales in the nearshore waters of VA. Photo-ID efforts have identified 18 individuals, and five of these have returned to VA in two successive years.

Public Outreach

Perhaps the most important contribution of the museum to the conservation of sea turtles and marine mammals is its public awareness program. More than 335,000 people, including 39,000 schoolchildren, visit the museum annually and learn through creative, hands-on exhibits the importance of our environment to the health of these threatened animals.

The museum also provides unique opportunities to the public to experience dolphin and whales in their natural environment, through their marine mammal cruises in the Chesapeake Bay (for more information, call 804-437-4949).

James Madison University
Ann Pabst/William A. McLellan
Department of Biology
Harrisonburg, VA

Marine Mammal Research

An important component of any



More than 300 strandings of marine mammals and sea turtles have been investigated through the Virginia Stranding Program operated by VMSM and VIMS. Tissue samples from dead animals (like the stranded humpback whale, above) are analyzed by researchers at JMU. Information gained from each salvaged animal is invaluable, yielding insights not only into how it may have died, but also how it made its living.

North Carolina border to Cape Henry. The beach was patrolled from mid-May through mid-September, 1993. Once located, eggs were reburied in predator-proof nests on the refuge.

Due to human activity along VA's beaches south of Cape Henry, turtle nests have very little chance of hatching. By removing the eggs from nests and placing them in protected areas on the refuge, hatching rates can exceed 90 percent. It is hoped that such efforts will help in-

crease the population of nesting loggerheads between nesting attempts and whether or not they re-nest on the same beaches.

Virginia Marine Science Museum
Mark Swingle
Virginia Beach, VA

Stranding Program

Initiated in 1989, this program is dedicated to the rescue, rehabilitation, and research of marine animals. More than 300 strandings of endangered and protected species such as dolphins, whales and sea turtles on beaches from the Eastern Shore to North Carolina have been investigated, with the help of 7,000 hours of volunteer time. Ill or injured animals are transported for treatment, and tissue and other sam-

conservation plan is knowing the basic biology of the animals you are trying to protect. Ann Pabst and William McLellan are involved in research designed to learn how cetaceans—whales, dolphins and porpoises—are functionally adapted to their marine environment. Specific questions they are asking include: How do cetaceans power their locomotion? How do they give birth to young that are fully functional swimming machines?

They approach these questions by conducting research from the “inside out”—that is, they dissect cetaceans that have either stranded or been taken incidental to fishing operations. Each salvaged animal is invaluable, yielding insights not only into how it may have died, but also how it made its living. They use tissues to study the function and development of their locomotor, reproductive and cardiovascular systems.

This work has already yielded valuable results. For example, an important component of any conservation plan is knowing the movement patterns of the animals. Tracking individual dolphins and porpoises is usually done by attaching radio or satellite tags to the dorsal fin. Their cooperative research with the Smithsonian Institution has shown that the dorsal fin and flukes are full of blood vessels that the animal uses to regulate its body temperature. Blood that is pumped through vessels on the surface of the dorsal fin and flukes is cooled by exposure to the relatively cool water. Some of those blood vessels are used to control the temperature of the reproductive system—to cool the male testis, which lies within the abdominal cavity, and potentially to cool the developing fetus while it is in the uterus. Attaching dorsal fin tags to these animals potentially can damage these blood vessels and affect its health and that of its offspring. Currently, these researchers are working with others to minimize harmful effects of these tags to these animals.

Christopher Newport University (CNU)

Sherman Jones, III

**Field Studies for the College of Science and Technology
Newport News, VA**

Dolphin Project

Since May, 1992, Sherman Jones and his staff have been involved with a small boat survey, photo-ID study of bottlenose dolphins in the Chesapeake Bay. They have conducted a total of 62 cruises, taken nearly 2500 photographs, and currently have a catalog including 145 recognizable individual dolphins. Their photographic records also include other marine mammals and sea turtles they encountered.

CNU also sponsors a quarterly newsletter for the Atlantic Dolphin

of Natural History are well-known for their long-term studies of the life history of the bottlenose dolphin, *Tursiops truncatus*. Mead and Potter recently published the results of 15 years work in which they speculated on the existence of two or more populations of bottlenose dolphins in the northwest Atlantic.

Using detailed measurements of the skull, the researchers created a mathematical formula by which the offshore type could be differentiated from the coastal form. They determined also that the offshore specimens are infected with three very specific parasite species, the life histories of which make them useful as “biological tags.”

The work of Potter and Mead is critical to understanding the biolog-



Keith D. Mullin, NMFS

Research Network, and offers courses on marine mammals, including a “Bottlenose Dolphin Field School,” on VA’s Eastern Shore.

National Museum of Natural History

**James G. Mead, Charles W. Potter
Smithsonian Institution
Washington, D.C.**

Marine Mammal Program

Apart from serving as an important national clearinghouse of information on marine mammals, mammalogists at the National Museum

Several research activities in VA center around the most common marine mammal in our waters, the Atlantic bottlenose dolphin (*above*). For example, the 15 years of research performed by the National Museum of Natural History was critical in determining the biological significance of the massive die-off of these dolphins in the late 1980’s. In addition, researchers at CNU are establishing a photographic identification catalog of the bottlenose dolphins frequenting our waters, which should help scientists understand more about the movements and behavior of the species.

ical significance of the massive die-off of bottlenose dolphins along the East Coast during the late 1980’s. For example, through their findings, we now know that the die-off was limited to the coastal population.

What You Can Do To Help:

*** If you find any sea turtle or marine mammal, dead or alive,** please contact: *Virginia's Stranding Network* (804/642-7313 or 804/437-4961) as soon as possible.

*** Learn more about sea turtle and marine mammal biology and ecology.** Contact:

Department of Marine Advisory Services, Sea Grant Office, VIMS,

Virginia Bay Team. Offers traveling classroom outreach and teacher training programs. Contact: VIMS Marine Education Program, P.O. Box 1346, Gloucester Point, VA 23062 (804/642-7172).

Virginia Marine Science Museum. Offers a variety of educational programs, including whale and dolphin watches, a traveling Chesapeake Bay Marine Lab, and a teacher recertification program. Contact VMSM Schedule Coordinator, 717 General Booth Blvd., VA Beach, VA 23451 (804/437-4949). Request a copy of their School Program Guide.

Bottlenose Dolphin Field School. Christopher Newport College offers a field course each spring to teach the serious student about dolphin biology and ecology. Write to: CNU, Bottlenose Dolphin Field School, Dept. of Biology, Chemistry and Environmental Science, 50 Shoe Lane, Newport News, VA, 23606.

***Make your voice heard!** As Congress takes up the reauthorization of the *Endangered Species Act*

(ESA), the *Marine Mammal Protection Act* (MMPA), the *Clean Water Act*, and the *Magnuson Fisheries Conservation and Management Act* (FCMA), it is critical that supporters of fish and wildlife conservation take a stand. Please write and urge your Representative to cosponsor H.R. 2043, and Senators to cosponsor S921, the ESA Amendments of 1993, and oppose any weakening attempts.

For information on where your legislators stand on the ESA issue, contact Suzanne Jones, *National Wildlife Federation* (NWF), 1400 Sixteenth Street, N.W., Washington, D.C. 20036 (202/797-6666). To get in-

volved on the grassroots level for ESA reauthorization, contact Dana McDaniel, NWF (202/797-6864).

The MMPA faces serious, crippling amendments. For legislative updates on MMPA, FCMA, and the Clean Water Act, contact the *Center for Marine Conservation*, 1725 DeSales, St., NW, Washington, DC 20036 (202/429-5609).

*** Help stop the dumping of marine plastics and other debris** which is harmful to sea turtles and marine mammals. Call or write, *Defenders of Wildlife*, 1244 19th St. NW, Washington, D.C. 202/659-9510.

*** Pay attention to potential toxic materials that you store outside and to what is poured down your drain.** For more information, write to: *Alliance for the Chesapeake Bay*, P.O. Box 1981, Richmond, Virginia, 23216 or the *Chesapeake Regional Information Service Hotline* (CRIS), 1-800-662-2477. Ask for a copy of the "Bay Book."

The VA Dept. of *Environmental Quality* also provides public information on environmental quality and Bay cleanup. Contact DEQ, Public Affairs, POB 10009, Richmond, VA 23234 (804/762-4570).

*** Save our Streams**—The Izaak Walton League of America is active in water quality monitoring and other efforts to help stop water pollution on the local level. Write to: *Izaak Walton League*, Save our Streams Program, 1401 Wilson Blvd., Level B, Arlington, VA 22209-2318.

*** Visit the VIMS Aquarium** (804/851-6734), *Virginia Marine Science Museum* (804/437-4949), the *National Museum of Natural History* (202/786-2497), and the *National Aquarium in Baltimore*, MD (410/576-3849).

*** Become active in local land-use planning, zoning, and population issues.** Ultimately, it is the encroachment of humans that is the greatest threat to the survival of our aquatic and terrestrial wildlife. □



Public education is critical to the conservation of marine mammals and sea turtles. Through the use of hands-on exhibits (like the Atlantic loggerhead sea turtle sculpture above) and whale-watching expeditions, the Virginia Marine Science Museum has educated more than 335,000 people about the importance of endangered and threatened animals everywhere.

Gloucester Point, VA 23062 (804/642-7169) for marine environmental education information.

Communications Coordinator, *Virginia Sea Grant College Program*, 170 Rugby Road, UVA, Charlottesville, Virginia, 22903, 804/924-5965 for a free copy of their "Publications Directory."

Marine Turtle Newsletter. Worldwide happenings in sea turtle conservation, management and research. Write to: Editors, *Marine Turtle Newsletter*, Hubbs-Sea World Research Institute, 1700 South Shores Road, San Diego, CA 92109.

Photo TipS

By Lynda Richardson

Congratulations to all the brave souls who entered *Your First Magazine Assignment!* (May 1993) We had a total of 32 entries submitted by eight people from all over Virginia. Everyone did well at following the submission guidelines and theme of the assignment. As a matter of fact, people did so well that I really had a tough time picking out just three images for publication.

As mentioned in the May 1993 *Photo Tips*, I wanted inspired readers to travel around Virginia and snap photographs concentrating on patterns and textures found in nature. Images submitted would be judged on use of color (or lack of it), use of light, and choice of subject matter.

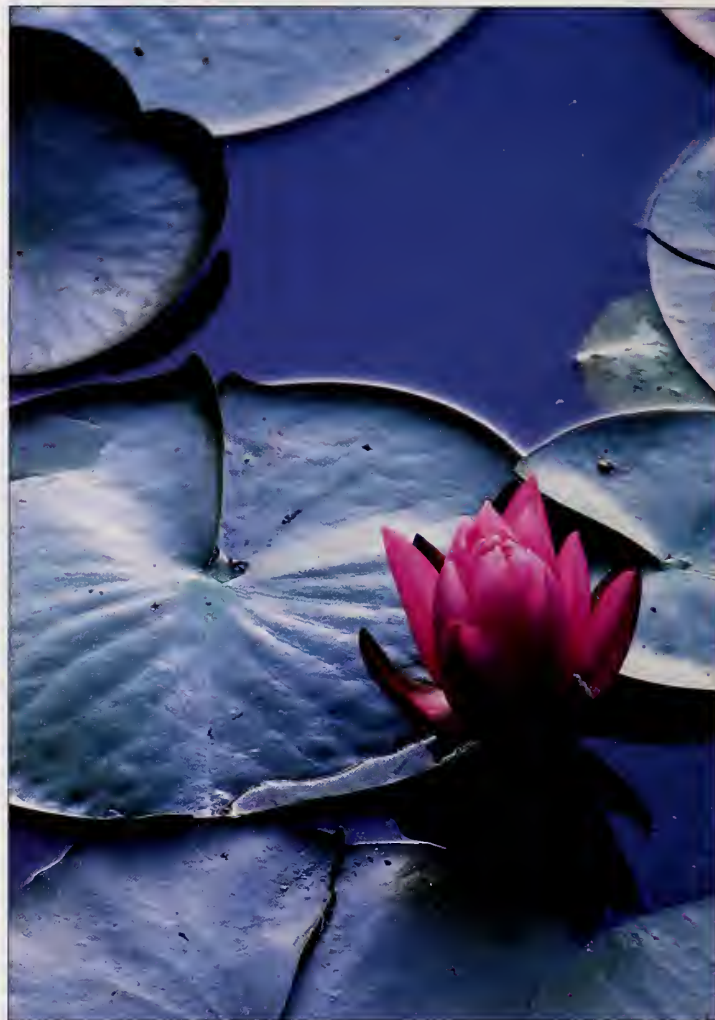
The use of contrasting color, interesting light and composition was what clinched it for Caroline Watts of Madison. Focusing in on a water lily blossom and placing it in the right hand bottom corner of the frame, Caroline was able to grab the viewer's attention with this use of "single spot" color. The fact that the pink contrasted well against the cooler greens and blues made the pink stand out even more.

After noting the flower, your eye naturally moves to the large lily pad on the left and then into the "dead space" above. I believe this use of empty space really adds to the impact of this photograph. The sidelit/backlit lighting adds a soft texture to the scene making it a particularly pleasing one. Good job!

Whereas contrasting colors enhanced Caroline's lily shot, the uni-

form color of sassafras leaves after a rainstorm made this next image work just as well. Taken by Jim and Micaela Bulich of Stuarts Draft, the rich greens captured under muted light and sprinkled with rain seemed so perfect and simple that one might suspect they had been arranged by a floral designer. As the lovely composition unfolds, hand-like leaves seem to point and guide your eyes around the image. The overall texture is accented by light refracting through rain droplets which really "makes" the photograph. (All the more reason to go out and shoot in or after a rain shower.) Another job well done.

The close-up of a dandelion seed head was my third pick and this unusual photograph was submitted by R. Anthony Todt of Fredericksburg. Though the slide is a bit grainy and not as sharp as the oth-



*First Place
Water lilies
Photography by Caroline Watts*

ers, I believe that this actually helps the image by emphasizing the overall feel of softness and giving it a mysterious, almost alien look. Anthony's decision to shoot the scene with a brown background adds a feeling of warmth. By choosing a

“Your First Magazine Assignment”—The Results



Second Place

Sassafras leaves after a rain storm

Photography by Jim & Micaela Bulich

color within the subject and carrying it into the background, Anthony created a continuity similar to the Bulich's monochromatic shot. Great job!

If your photograph wasn't chosen this time, don't be dismayed.



Third Place

Seed head of a dandelion

Photography by R. Anthony Todt

Everyone sent in a wonderful selection, and again, it was a hard decision to pick three. Let me assure you that not being selected even happens to the “Big Boys,” the internationally famous pros. The secret is not to be discouraged. You must be

persistent, imaginative, and don't be afraid to go out there and experiment. And you will have another chance. Be sure to check out the 1994 May issue of *Virginia Wildlife* for *Your Second Magazine Assignment*.

Recipes

By Joan Cone

Enjoying Wild Turkey Leftovers

From the cook's standpoint, all turkeys are alike. Wild ones run about the same size as the domestic varieties and have less fat. Flavor is about the same. So, you are faced with a delicious, very large bird that tends to be slightly dry and benefits from a moist form of cooking.

The dressed weight for a wild turkey is eight to 16 pounds. No doubt you will have leftovers which can be used in the following cobbler recipe.

MENU

Sesame Cheese Sticks

Wild Turkey Cobbler

Black-eyed Pea Curry

Orange Cups with Lemon Mousse

Sesame Cheese Sticks

1 cup packaged pie crust mix
Dash salt
½ cup grated sharp Cheddar cheese
2 tablespoons cream sherry
1 tablespoon sesame seeds

Combine pie crust mix, salt and cheese, mixing lightly with a fork. Add sherry and mix until all ingredients are evenly moistened; shape dough into a ball. Roll to a 6-inch square on lightly floured board. Sprinkle sesame seeds evenly into dough. Cut into strips 3-inches by ¾-inch. Arrange on ungreased baking sheet and bake at 450 degrees for 8 to 10 minutes. Remove to a wire rack to cool before storing in an airtight container. Makes about 2 dozen.

Wild Turkey Cobbler

¼ cup margarine or butter
1½ tablespoons flour
½ pound fresh mushrooms, chopped

4 celery stalks, thinly sliced
1 cup turkey or chicken broth
1 cup milk
2 egg yolks, well beaten
2 tablespoons sherry, optional
3½ cups cubed, cooked turkey
Salt and pepper to taste
¼ cup grated Parmesan cheese

Grease a 13-inch by 9-inch baking pan or dish. In a large saucepan, melt margarine over low heat. Whisk in flour; increase heat to medium and add mushrooms, celery, broth, milk, egg yolks and sherry. Increase heat and bring to a boil, stir in turkey, salt and pepper. Pour into greased baking pan and sprinkle with Parmesan cheese on top and set aside.

Cornbread Herb Crust:

1 cup flour
1 cup yellow or white cornmeal
2½ teaspoons baking powder
2 tablespoons sugar
1 teaspoon Italian seasoning
Pinch salt
¼ cup margarine or butter, melted
½ cup milk
1 egg, well beaten

Preheat oven to 400 degrees. In a large bowl, combine crust ingredients. Stir vigorously with a wooden spoon about 30 seconds until a soft dough forms. Spoon herb dough over turkey filling to create a cobblestone effect. Bake 30 to 35 minutes or until a toothpick inserted in center comes out clean. Makes 8 to 10 servings.

Black-Eyed Pea Curry

1 medium potato, peeled, cut into ½-inch pieces
2 cans (15 ounces each) black-eyed peas, drained
½ cup water
2 teaspoons minced fresh ginger

¼ teaspoon turmeric
2 tablespoons vegetable oil
1 cup chopped onion
1 teaspoon curry powder
½ cup chopped tomato
¼ cup chopped fresh parsley

Boil potato in medium pot of boiling salted water until tender; drain. Blend ½ cup black-eyed peas, ½ cup water, ginger and turmeric in processor until smooth. Heat oil in heavy skillet over medium heat. Add onion and sauté until translucent, about 5 minutes. Add curry powder and stir about 1 minute. Add remaining ½ cup black-eyed peas, puree from processor, potato and tomato to skillet. Cook until mixture is thick and creamy, stirring occasionally, about 5 minutes. Season to taste with salt and pepper. Transfer curry to large bowl and garnish with chopped parsley. Makes 4 servings.

Orange Cups with Lemon Mousse

3 navel oranges, halved
1 package (8 ounces) light cream cheese
¼ cup lemon nonfat yogurt
1 tablespoon fresh-squeezed lemon juice
2 tablespoons sugar
Ground nutmeg
Slivered orange peel for garnish

Using a grapefruit knife, remove fruit from orange halves, leaving 4 shells intact. Chop fruit; spoon into 4 reserved orange shells. (Use remaining orange peel for garnish.) In blender container or food processor bowl, combine cream cheese, yogurt, lemon juice and sugar. Cover and process until smooth. Spoon some of the mousse mixture over each orange cup; sprinkle with ground nutmeg and orange peel. Makes 4 servings. □



Safety

by Col. William Antozzi, Boating Safety Officer

Cold Weather Catastrophes

In cold weather, the fisherman or hunter in his boat is a "sitting duck" himself if he fails to take adequate precautions.

There is no guarantee that the cold weather boater is going to stay dry. A sudden dunking or rain shower can result in a life threatening situation. Dry clothing in a waterproof bag is very important to health and welfare when a "soaking" occurs. Included in the bag should be several layers of clothing, mittens, footwear, and a warm hat or cap.

When the body is attacked by cold air, water, or both, the body defense is to reduce the blood in the extremities—that is the arms and legs, to maintain circulation to vital organs in the trunk, groin, and head. Heat loss from the head alone can be critical because over a third of body heat can be lost from that area. More than 40 percent of body heat can be lost from the head in water that is 40 degrees Fahrenheit. It is particularly important to insulate the trunk, groin and head to insure continued functions in those areas of the body.

The body also uses a significant amount of heat in warming air that is taken in by breathing. That heat is then lost when the air is expired. Of course, heat loss is greatest when breathing is rapid. Air entering the lungs is humidified by the body, so heat is lost through evapora-

tion from the lungs as well. All of this proves that too much exercise in the cold is detrimental to maintaining body heat. It should be remembered also that exercise can result in perspiration which still has a cooling effect when the exercise stops.

When blood is shunted to the groin, trunk and head from the legs and arms, it is done by constriction of blood vessels (vasoconstriction) and blood volume in the trunk is in-

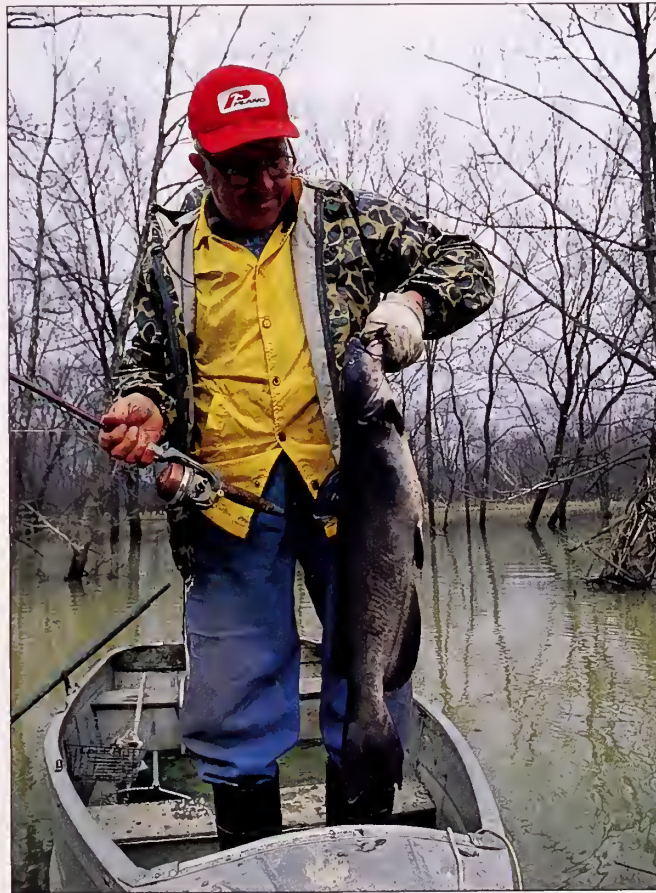
creased. The blood passes through the kidneys more frequently and water is removed to lower the blood volume. The result is more frequent urination.

Shivering can increase metabolic heat production from five to seven times when out of the water and is about 50 percent effective in preventing reduction of body temperature. In the water, it is only about 11 percent effective. Shivering is an indication that the body is losing heat

and immediate action must be taken to remedy the situation. Heat loss in sufficient quantity to cause inertia and death is called hypothermia.

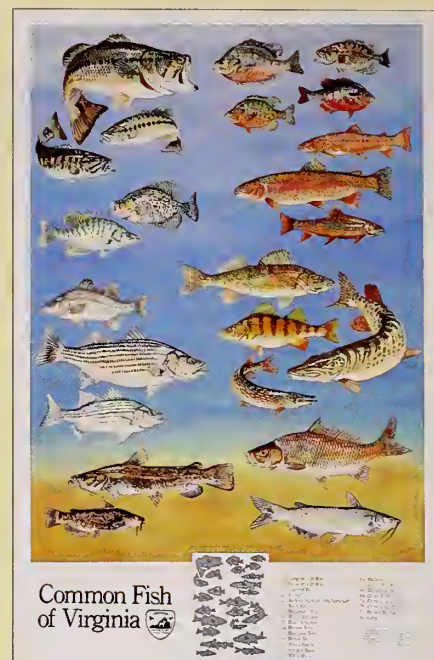
Physical activity increases heat production and heat loss. People in poor physical condition breathe more often than those who are physically fit and therefore lose more heat through respiration. Therefore, a boater who finds himself in cold water should generally not try to swim to shore, but should attempt to get as much of his body out of the water as possible. Water also conducts heat away from the body 25 times faster than air.

When water temperature is reduced to 60 degrees Fahrenheit or below, boaters should wear special attire to keep them warm and dry in case of immersion. Such clothing is somewhat expensive, but well worth wearing. It may be a lifesaver. □

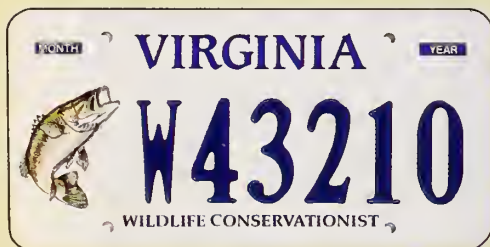


Boating can be dangerous in cold weather, and this boater could be in for a catastrophe. Always wear your life jacket, and carry a change of dry clothes in case you get wet! Photo by Soc Clay.

Put Swimming Fish on your walls!



The Virginia Department of Game and Inland Fisheries has produced two full-color fish identification posters. Just released is a 21 3/4" X 34" poster of 24 species of saltwater fish in Virginia. The second is a 21" X 36" poster of 23 freshwater game fish in Virginia. Each is available for only \$8! Specify which poster you'd like and send your check (made payable to the Treasurer of Virginia) to: Fish Poster, VDGIF, P.O. Box 11104, Richmond, VA 23230-1104.



Give Wildlife A Ride

Why not show your concern for wildlife by ordering a Wildlife Conservationist license plate from the Department of Motor Vehicles? Choose either the largemouth bass or mallard license plate featured here and help the Virginia Department of Game and Inland Fisheries fund wildlife conservation management and research projects. For ordering information, see gray card in this magazine.

Virginia Wildlife Gift Catalog

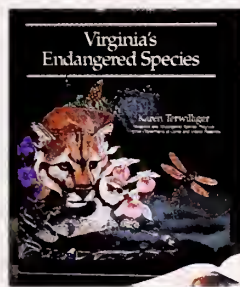
Virginia's Endangered Species

Produced by VDGIF along with other state resource agencies, this 675-page book with 229 color plates, 331 black and white figures, two appendices and three indices is the definitive guide for the nature lover in your family wanting to know about Virginia's rare plants, fish, reptiles, amphibians, mammals, invertebrates, and birds.

Available for \$32.95 (softcover) or \$59.95 (hardcover) plus 4.5 percent sales tax and \$3.50 shipping and handling charges (per book) from: McDonald and Woodward Publishing Company, P.O. Box 10308, Blacksburg, VA 24062-0308. Phone: 703/951-9465.



Endangered Species poster



Winter Comfort

by Bob Henley

Order Bob Henley's limited edition fox print of 950 for only \$45. Or, for an even better deal, order two subscriptions to *Virginia Wildlife* and get the fox print for only \$35! You can read *Virginia Wildlife* all year long, send a subscription to a friend, and still save \$10 on a one-of-a-kind wildlife print! Use the gray card in this magazine to order today!



Lee Walker

Wear Your Support— Buy a T-Shirt!

Support Virginia's Nongame and Endangered Species program by wearing one of our brand-new beautiful t-shirts! Only \$12 each (plus \$2.50 postage and handling), they're available in medium, large, and extra large only. Send your order in with a check for \$14.50 (for each t-shirt ordered) made out to the Treasurer of Virginia to: T-Shirt Offer, VDGIF, Attn: Toni Harrison, P.O. Box 11104, Richmond, VA 23230-1104.

Virginia Wildlife posters

Order any of the four full-color posters featured on this page (barred owl, white-tailed deer, wood duck, or Endangered Species) for \$8 each. Just send your check made out to the Treasurer of Virginia and specify the number and kind of posters ordered to: Virginia Wildlife, Poster Offer, VDGIF, P.O. Box 11104, Richmond, VA 23230-1104.

Poster Specifications:

Endangered Species poster: 18" X 24"
Virginia Wildlife posters: 19 1/2" X 27 1/2"



Preserving in bronze what we're losing in the wild

An Endangered Species Series by Turner Sculpture

Continuing to capture the essence of Virginia's endangered species in bronze, David Turner of Turner Sculpture has created the third in his Endangered Species Series to raise funds for Virginia's Nongame and Endangered Species Program.

Turning to the wind-swept beaches and mudflats of his native Eastern Shore, David has chosen to capture the spirit of the delicate, yet spritely piping plover in bronze. Perfectly camouflaged among the speckled beaches, the piping plover can disappear from view in an instant, blending into the landscape with the help of its sand-colored body, black collar, and a black nick of a crown between the eyes.

This federally endangered shorebird is teetering on the brink of extinction, and every year we hold our breath hoping to see signs of recovery. One-quarter of the East Coast piping plover population nests on the beaches of Virginia's barrier islands, struggling to increase its numbers amid the hardships of habitat loss, nest destruction, and predators hungry for a meal of eggs or tiny young.

Like the Northern flying squirrel (featured above) and the sold-out Bewick's wren sculpture, a limited edition of 200 piping plovers will be cast and sold solely to benefit Virginia's Nongame and Endangered Species Program, the program responsible for the management and protection of all the Commonwealth's rare and endangered wildlife. The money raised from the sale of the three sculptures will provide the program with over 1/10th of its present operating budget.

Each sculpture has a purchase price of \$325. Turner Sculpture will receive \$175 to cover their production costs, while the remaining \$150 will be sent to the Virginia Department of Game and Inland Fisheries as your contribution to Virginia's Nongame and Endangered Species Fund. A tax advisor should be consulted regarding the personal tax deductibility of this contribution. Each piece sold will include a certificate of origin and a letter confirming your contribution to the future of Virginia's wildlife.

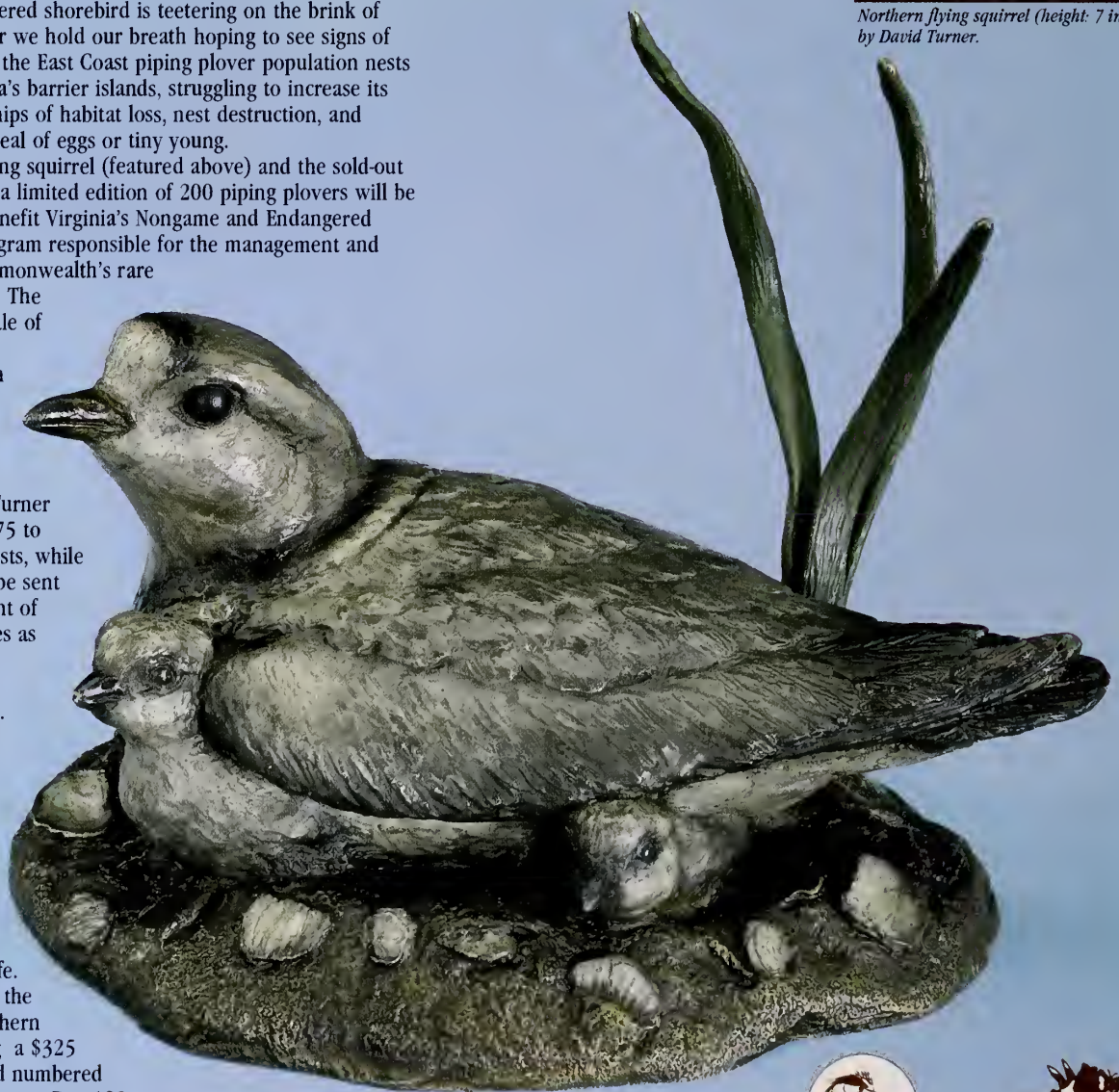
You may order either the piping plover or the Northern flying squirrel by sending a \$325 check for each signed and numbered sculpture to: Turner Sculpture, Box 128, Onley, VA 23418. For credit card orders, call: 804/787-2818.

Note: if you have already purchased a Bewick's wren or Northern flying squirrel and would like the same limited edition number in the piping plover, please send in your order as soon as possible.

Photo of piping plover approximates actual size.



*Northern flying squirrel (height: 7 inches)
by David Turner.*



TURNER
SCULPTURE



Nongame and Endangered
WILDLIFE PROGRAM
VIRGINIA DEPARTMENT OF GAME AND INLAND FISHERIES

"In the belly of all this beauty are the hard truths of absolutes—living and dying, the reminder that the natural world cares not for any single life but only for life itself, connected and whole, abiding. That is what this grand opera of sunlight and wind, sea and fish, sand and grass and tides is about: the maintenance not of the living but of life."

—Harry Middleton

(from Rivers of Memory, Pruett Publishing Co. 1993)



